THE REVIEW OF APPLIED ENTOMOLOGY

SERIES B. MEDICAL AND VETERINARY

VOL. 43
(1955)

ISSUED BY THE COMMONWEALTH INSTITUTE OF ENTOMOLOGY

LONDON:
COMMONWEALTH INSTITUTE OF ENTOMOLOGY,
56, QUEEN'S GATE, S.W.7
1957

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Commonwealth Agricultural Bureaux

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ERRATA

Page 31 line 6 for "1952" read "1952 [published 1954]"
,, 75 line 18 from end, for "**parenteralein**" read "**parenterale.**"
,, 120 line 2 for "in" read "is"
,, 122 line 17 from end for "**Mcrofilariae**" read "**Microfilariae**"
,, 124 line 17 for "housing education" read "housing, education"

COMMONWEALTH INSTITUTE OF ENTOMOLOGY.

REVIEW
OF
APPLIED ENTOMOLOGY.

SERIES B.

Vol. 43. 1955.

Report of the Sixth Commonwealth Entomological Conference 7th–16th July 1954.—iv + 344 pp., 5 figs., refs. London, Commonw. Inst. Ent., 1954. Price £1 10*s*.

This report, which is noticed as a whole elsewhere [*R.A.E.*, A **43** 1–2], includes a number of appendices. One of these contains the text of the papers read at the open meetings, with full summaries of the discussions on them, and another comprises a series of reviews of work on economic entomology in Commonwealth countries during 1948–54. The papers read [*cf. loc. cit.*] included: Aircraft Applications of Insecticides against Tsetse Flies [*Glossina*] and other Insect Pests in East Africa, pp. 44–48, 12 refs., by D. YEO; The Development of Resistance to Insecticides, pp. 60–65, 49 refs., by J. R. BUSVINE; and Recent Advances in Tsetse Research and Control, pp. 143–147, by C. H. N. JACKSON. Most of the reviews of work on economic entomology were prepared by the chief entomologists of the government departments that deal with agriculture, but some of them [*cf. loc. cit.*] include information on *Glossina* spp. in the Gold Coast, Nigeria and Northern and Southern Rhodesia, on species of *Chrysops* that are vectors of *Loa loa* in Nigeria, and on other pests of medical and veterinary importance in Australia, Canada, Malaya and the Gold Coast.

LEWIS (C. T.). **Studies concerning the Uptake of Contact Insecticides. I.—The Anatomy of the Tarsi of certain Diptera of medical Importance.** —*Bull. ent. Res.* **45** pt. 4 pp. 711–722, 5 figs., 17 refs. London, 1954.

The following is the author's summary. The anatomy of the tarsi and pretarsi of *Phormia* (*Protophormia*) *terraenovae* R.-D., *Glossina palpalis* (R.-D.) and *Musca domestica* L. is described, with particular reference to structures possibly concerned in the action of deposits of contact insecticides. The numerous setae which cover the tarsal segments are distributed in a pattern which is common to all three species. Long spines situated at the distal extremity of each segment are the points of contact with which a fly engages a surface, and which take the thrust as the fly walks. Proximal to the primary spines are two ventral rows of chemoreceptors, protected from mechanical damage by smaller spines. In addition there are lateral and dorsal rows of bristles.

(1759) Wt. P17/3897 2/55 E.P. Ltd. Gp. 566. [B]

Contact chemoreceptors, which have been identified by experiment, are present in large numbers on the tarsi of *P. terraenovae* and *M. domestica*. Each chemoreceptor is a differentiated hollow seta possessing an extremely thin frontal membrane of cuticle, in which a lipoid layer appears to be incorporated and through which a lipoid-soluble insecticide might readily penetrate to the sensory neurocytes.

Receptors of this type are also present on the tarsi of *G. palpalis*, though tsetse flies have not been reported to possess a tarsal gustatory sense.

The pulvilli of all three species are entirely filled with viscous endocuticle and possess neither nerves, sense organs nor gland cells. The pulvilli are probably less important sites of penetration of insecticide from deposits than are the tarsal chemoreceptors, articulating membranes of setae, and intersegmental joint membranes.

Measurements of nerve diameters at different parts of the tarsi are used to interpret the results of Fisher [*R.A.E.*, B **41** 208] concerning the action of DDT applied to limited areas of *M. domestica*. It is concluded that the relative toxicity of DDT at different parts of the body may be correlated with the number of sensory nerve fibres passing close to the site of penetration, but not with the number of sensory end organs directly affected.

YEO (D.). **Aircraft Applications of Insecticides in East Africa. IX. Further Experiments on the Deposition in open Country of a coarse Aerosol released from an Aircraft.**—*Bull. ent. Res.* **45** pt. 4 pp. 745–749, 3 graphs, 4 refs. London, 1954.

The following is the author's summary. Further experiments have been carried out to investigate how a coarse aerosol, released from a low-flying aircraft, is deposited upon the ground in open country [*cf. R.A.E.*, B **42** 57–58]. The aerosol had a mass median diameter of approximately 80 microns, and was produced by a boom-and-nozzle apparatus.

The aircraft height was 65 ft. It is shown that the rate of deposition is related to the degree of atmospheric turbulence, of which a simple and easily measured parameter is given. The rate of deposition is greatest when there is a large temperature inversion and a low wind speed.

A comparison is made with previous work where the aircraft height was 30 ft. [*loc. cit.*]. Within the limits investigated, an increase in aircraft height reduces the deposits near the line of emission, but does not greatly affect the total amount that deposits within 150–200 seconds of production of the aerosol.

NIELSEN (E. T.) & HAEGER (J. S.). **Pupation and Emergence in *Aëdes taeniorhynchus* (Wied.).**—*Bull. ent. Res.* **45** pt. 4 pp. 757–768, 2 graphs. London, 1954.

The following is virtually the authors' summary. Field observations and rearing experiments were carried out in Florida to gain information on the duration of the larval stage and the time of day of pupation and emergence of the salt-marsh mosquito, *Aëdes taeniorhynchus* (Wied.). The technique is described.

It was found that the duration of the larval stage depends on several factors, of which water temperature is probably the main one. Hunger, either through lack of food or overcrowding, was also shown to be important. Males pupated before females. The period of maximum pupation is determined by the distribution of light and darkness, 83 per cent. of all pupation taking place during the evening periods, 15–24 hours after experimental

midnight, and 48 per cent. in the period just after sunset, 18–21 hours after experimental midnight. The tendency to pupate in the evening is thought to have just as much accelerating as retarding effect on the larval development. Temperature is considered to be the only factor of importance in determining the duration of the pupal stage, which varies from 61 hours at 20·8°C. [69·44°F.] to 45 hours at 25·5°C. [77·9°F.] and 37 hours at 29°C. [84·2°F.].

Both in nature and under controlled conditions in the laboratory it was found that, for a large number of larvae hatched simultaneously, the emergence of adults usually lasts three or four days, with a maximum at the same hour on each of these days. The period of emergence is proportional to the duration of the post-embryonic development and may last weeks under unfavourable conditions. Maximum emergence was found to occur at various times of the day, as would be expected with pupation in the evening, and the duration of the pupal stage solely dependent on the temperature. The difference in the duration of the pupal stage in males and females is very small but the rather marked sexual difference in the duration of the larval stage (129 hours for males against 145 for females at 29°C.) results in a preponderance of males during the first emergence maxima and of females in the last.

It is concluded that if the temperature of the water in which the larvae are living in the field is known, it should be possible to predict at what hour of the day the emergence maxima will take place.

Lewis (D. J.). **Muscidae of medical Interest in the Anglo-Egyptian Sudan.**—*Bull. ent. Res.* **45** pt. 4 pp. 783–796, 3 maps, 59 refs. London, 1954.

The main part of this paper comprises a list of 79 species of Muscids of some medical interest that occur in the Sudan, with records of their distribution there and notes on the habits of several. The seven species of *Glossina* that occur in the Sudan are not included. An introductory section includes brief notes on the relation of flies to the transmission of cattle trypanosomiasis in the Upper Nile area, where it is an important problem in the absence of *Glossina*. Buxton has concluded that transmission by other biting flies in general does not satisfactorily explain the situation, because there are several areas in the south in which the disease appears to be strictly associated with tsetse belts and is absent from neighbouring districts where Tabanids, *Stomoxys* and other biting flies are abundant. He suggests that the blood-drinking Muscids, which do not pierce the skin but feed at ulcers and other injuries, may be involved. There is little doubt that biting Muscids are a contributory cause of the movements of cattle largely designed to protect them from Tabanids [*R.A.E.*, B **41** 118].

Squire (F. A.). **Observations on the Incidence of Trypanosomes in *Glossina palpalis* (R.-D.) in Sierra Leone.**—*Bull. ent. Res.* **45** pt. 4 pp. 797–801, 1 graph, 4 refs. London, 1954.

The following is the author's summary. Observations were made in Sierra Leone from September 1949 to November 1951 on the incidence of trypanosomes in *Glossina palpalis* (R.-D.), in continuation of those previously reported that began in September 1948 [*R.A.E.*, B **40** 4]. Flies were dissected; trypanosomes found to be restricted to the proboscis were classed as *Trypanosoma vivax* and those found also or only in the mid-gut as *T. congolense*. None of the flies had infected labial glands. The whole data are presented for the sexes separately by months.

The existence of a marked seasonal variation in the incidence of *T. vivax* in *G. palpalis* [*loc. cit.*] is confirmed. The highest rates of infection occurred in the months of heavy rain, and there was a significant inverse correlation between the monthly means of infection rate and of hours of sunshine. The cause is unknown, but possible explanations are discussed.

The older the fly, as judged by its appearance, the greater the rate of infection by both species of trypanosome; the virtual absence of infection in the youngest group of flies does not support the theory that they can only be infected when very young.

In the case of *T. vivax*, but not in that of *T. congolense*, female flies were more heavily infected than males. This may be due to a larger food intake by the females, or to males, because of their more active life, appearing to be older than they are.

RUPP (H.). **Contribution à la lutte contre les tsétsés. Influence " d'étoffes attractives ", imprégnées de DDT, sur** *Glossina palpalis*, **ssp.** *martinii* **Zpt.**—*Acta trop.* **9** no. 4 pp. 289–303, 7 figs., 16 refs. Basle, 1952. (With Summaries in English and German.)

The following is largely based on the author's summary. *Glossina palpalis martinii* Zumpt lives near water where the relative humidity of the air is high. In Ruanda Urundi, it is found on the banks of the river Ruzizi and its tributaries. The attractiveness of different colours (brown, blue, white and black) for the fly was studied, and it was found that black was the most attractive and blue next. Pieces of black material fluttering in the wind attracted it better than did Harris traps [*R.A.E.*, B **19** 78]. Pieces measuring 20 × 55 ins. were therefore impregnated with 3·3 gm. DDT by steeping them in an emulsified solution, and 22 of them were hung on cords over a winding stream at intervals of 30–100 yards for a distance of 1,100 yards measured in a straight line. This caused a remarkable reduction in the density of the fly. The population at a collecting point near the centre of the treated stretch had been reduced by 68·6 per cent. two and a half months after the beginning of the experiment, whereas it had risen in an untreated stretch upstream.

BURTT (E.). **The Occurrence in Nature of Tsetse Pupae** (*Glossina swynnertoni* **Austen**).—*Acta trop.* **9** no. 4 pp. 304–344, 19 figs., 11 refs. Basle, 1952. (With Summaries in German and French.)

The following is based on the author's summaries of this paper, which contains a brief review of previous observations on the sites in which pupae of *Glossina swynnertoni* Aust. have been found in Tanganyika and an account of an investigation carried out near Shinyanga during 1946–52. *G. swynnertoni* pupates in thickets under dead wood and overhanging rocks and at the foot of trees, but the pupae had not been found in these sites during the rainy season except in very dry years. Soon after the end of the rains, they could be found under deciduous bushes and in rot-holes in trees, but were plentiful in the latter only after the bush fires. They were once found in soil in the crown of a baobab tree 20 ft. above the ground.

The usual technique for obtaining pupae was to clear the ground of organic débris and then dig into the earth, but the method was changed early in 1952 during a very damp period. The surface of the soil was closely scrutinised inch by inch and from the end of April onwards it was also lightly scraped. Many more pupae were recovered in this way. Both at this time and at the beginning of the dry season that followed it, sites rich

in pupae always had bare soil with large pieces of dead wood or bushes that served as " perches " for the gravid flies. The difference between the wet season and the beginning of the dry season thus lies less in the type of breeding place than in the disposition of the pupae in the soil. Laboratory observations showed that larvae wetted by rain were unable to burrow and pupated on the surface, but it was impossible to distinguish the puparia until the soil had dried. Such surface pupae were generally viable, but larviposition was often delayed if only cold, damp soil was available, and sometimes pupation was not completed normally or the pupae died.

Gravid females kept in empty glass tubes generally deposited their larvae late in the afternoon. Those kept on sand deposited them about three hours earlier. Females in an advanced state of pregnancy often larviposited within a few minutes of transfer from glass tubes to soil that was warm (26°C. [78·8°F.]) and dry. It has not yet been determined whether the presence of " perches " over the breeding sites is of importance. In the laboratory, the gravid females remain motionless on the dry soil until larviposition, but if this does not occur on the same day, they can pass the night resting vertically on the wall of the container. In daylight, the larva is negatively phototactic, and it seems to be the posterior part that is sensitive to light. However, this negative phototaxis is not indispensable for burrowing, as larvae burrow, though not so deep, in complete darkness. Cold can also prevent or impede burrowing. On a hard surface, larvae generally pupate in about 40 minutes. In natural breeding sites, several pupae are often found grouped in a small space. Several of these groups may be found under one log. Sites used in one year are sometimes not used in others. There is some evidence that the use of the sites is associated with the presence of wart-hogs (*Phacochoerus*).

Dowling (M. A. C.). **Control of Malaria in Mauritius. Eradication of *Anopheles funestus* and *Aedes aegypti*.**—*Trans. R. Soc. trop. Med. Hyg.* **47** no. 3 pp. 177–189, 2 figs., 5 refs. London, 1953.

A scheme for the eradication of malaria from Mauritius, where it was probably introduced about a century ago, was begun in November 1948. The administration is described. The only measure used at first was the application of deposits of DDT or BHC to the interiors of buildings [*cf. R.A.E.*, B **39** 146–147] against *Anopheles funestus* Giles, which bred continuously throughout the year and maintained the infection on the coast at a high level, even during the relatively cold months of June–November, and *A. gambiae* Giles, which was virtually absent during the cool season, but probably played an important part in transmission during the hot, wet season of January–April. All the island was treated except the central zone, which was protected by efficient anti-malarial works. The first application was made between mid-January and May 1949 and further ones in September–December in 1949, 1950, 1951 and 1952. Churches and mills were treated as well as dwellings, outhouses and cattle-sheds. The sprays used were 5 per cent. DDT in kerosene and 5 per cent. DDT or BHC in wettable-powder suspension and they were applied to give deposits of 100–150 mg. DDT or 12–19 mg. γ BHC per sq. ft. It proved impracticable to compare the effectiveness of the treatments. BHC was abandoned early in 1950 as the large number of applications per year necessitated by its brief period of effectiveness made its use uneconomic in view of the high cost of labour. Supona-D, an oil-bound suspension of DDT that mixes readily with water [*cf.* **40** 111], was introduced in 1951. It marked surfaces much less than the wettable powder and was much cheaper than the kerosene solution.

Spleen rates found in children less than 16 years old over the whole island in 1948, 1949, 1950 and 1951 were 34·8, 15·3, 2·8 and 2·5 per cent. Corresponding parasite rates in these years and 1952 were 9·5, 2·4, 0·4, 0·1 and 0·05 per cent. The parasite rate in children under three years old in the coastal zone was over 10 per cent. in 1948, but no parasites were found in 13,575 children of this age group in 1952. Malaria notifications, though inaccurate, also indicated that the disease had almost died out by 1952.

On the basis of day-time spray catches in several thousand representative houses, it was found that the number of Anophelines per 100 houses fell from 435 just before spraying to 2·7, 0·7, 0·2 and 0·04 in the years 1949–52. *A. funestus* was eliminated by the end of 1950 and *Aëdes aegypti* (L.) in 1949. *Anopheles gambiae*, though apparently reduced by 98 per cent. in 1950 as compared with the 1948 figure, was found to be breeding in large numbers throughout the coastal region in March and April, and to be numerous in new, untreated houses and cow-sheds, while virtually absent from neighbouring treated houses. A preliminary experiment was begun in one district in October 1950 in an attempt to eradicate it with larvicide. A high-spreading oil containing 5 per cent. DDT was applied at 1–2 gals. per acre to the surface of permanent breeding places weekly for two months in the dry season. This treatment was followed by weekly checking and spot-oiling where larvae were found. The population of *A. gambiae* was considerably reduced, and the experiment was extended to the entire coastal zone during the dry season of 1951. The results were satisfactory at first, but an unusually heavy rainfall in February 1952 was followed by a sharp increase in breeding, particularly along the west coast, and all attempts at control were unavailing.

The intensification of effort that an attempt at eradication would involve was not considered economically justifiable, as success was not certain and there was no evidence that the greatly increased population of *A. gambiae* was transmitting malaria. Eradication as a policy was therefore abandoned, and a control scheme designed to be continued indefinitely on a diminishing scale was introduced in 1952. Under this scheme, major works were to be completed in the Port Louis area and within a radius of one mile of the airport to form a barrier against the reintroduction of *A. funestus* or the introduction of other vectors; houses in areas chosen on the basis of scientific data were to be treated with insecticides, preferably BHC as it is cheap and a single treatment should be adequate in view of the shortness of the malaria season with *A. gambiae* as the only vector; auxiliary larvicide treatment with DDT at about 4 oz. per acre in emulsified solution was to be carried out in townships; and a careful watch was to be kept for unsuspected foci of malaria or the presence of *A. funestus*. It was also suggested, in view of the observed zoophilous tendencies of *A. gambiae* in Mauritius [**39** 147], that cattle should be dipped in BHC at regular intervals.

BURTT (E.). **Attenuation of Virulence of *Trypanosoma brucei* correlated with Loss of salivary Gland Infection by a Tsetse-fly.**—*Trans. R. Soc. trop. Med. Hyg.* **47** no. 3 pp. 246–247, 2 refs. London, 1953.

Infection of the salivary glands of *Glossina* with polymorphic trypanosomes generally lasts throughout the life of the fly. However, in experiments with *G. morsitans* Westw. and *Trypanosoma brucei* in 1948, a fly that had been shown to have a salivary-gland infection caused only very transitory infections in a white rat and a rabbit and later failed to infect another rat and a golden hamster. When another fly infected with the same strain was fed on the rabbit, it produced a normal fatal infection. Saliva ejected

on glass slides by the original fly on four separate occasions showed no trypanosomes [*cf. R.A.E.*, B **37** 137]. It is concluded that the metacyclic trypanosomes were dying out and while still present were too feeble to produce an acute infection. In 1949, another rabbit infected with the same strain of *T. brucei* by *G. morsitans* also recovered, possibly for the same reason.

Mathis (W.), Pickett (V. B.) & Miller (W. O.). **Chemical Control of Rice Field Mosquitoes in Mississippi.**—*Publ. Hlth Rep.* **69** no. 9 pp. 803–807, 3 graphs, 3 refs. Washington, D.C., 1954.

The rice-fields of Mississippi are usually flooded for 4–6 weeks in May and June and are then allowed to dry. After the drying period, they are reflooded and usually remain under water until the grain is harvested. This cycle of water management, which is designed chiefly for the control of the rice water weevil, *Lissorhoptrus oryzophilus* Kuschel (*simplex*, auct.) [*cf. R.A.E.*, A **22** 498], together with drainage and reflooding for other cultural purposes or because of defects, favours the development of large adult populations of *Psorophora confinnis* (Lynch Arrib.) in June and July [*cf.* B **31** 93]. The control of this mosquito with insecticides was studied in 1952 and 1953. Treatment of the fields just before initial flooding with 3 lb. DDT per acre in a 3 per cent. emulsified solution effectively controlled larvae of *Anopheles* and *Psorophora* for only 4–5 weeks after flooding. Preflooding treatment with dieldrin at 1 lb. per acre in 1 per cent. emulsified solution applied from the ground in 1952 and from an aircraft in 1953 gave excellent control of *Psorophora* larvae for about ten weeks or throughout the rice-growing season. Similar treatment at 0·5 lb. dieldrin per acre four weeks later in the season gave excellent control of *Psorophora* during the observation period of seven weeks, but its ability to maintain control throughout the growing season of the rice has not been demonstrated. Treatment with dieldrin at 0·25 lb. per acre in emulsified solution or at 1 lb. as impregnated bentonite pellets [*cf.* B **40** 153] before flooding or at 1 lb. per acre in impregnated ground tobacco stems or bentonite pellets or treated pre-germinated seeds after flooding did not give satisfactory lasting control. All dieldrin treatments failed to give lasting control of Anopheline larvae. Dieldrin at 0·5 and 1 lb. per acre gave excellent control of *L. oryzophilus* regardless of time or method of treatment.

Colless (D. H.). **The Effect of DDT and Kerosene upon Adult Behaviour in *Anopheles balabacensis* Baisas (= *A. leucosphyrus* auct.).**—*Ann. trop. Med. Parasit.* **47** no. 3 pp. 261–271, 13 figs., 4 refs. Liverpool, 1953.

Direct observations were made on Labuan Island, North Borneo, of the effects of DDT and kerosene, when applied to the walls of a wooden house, on the resting and feeding behaviour of *Anopheles leucosphyrus balabacensis* Baisas; the females of this mosquito do not remain long in houses [*cf. R.A.E.*, B **42** 146], but about 80 per cent. of them rest on walls for 10–20 minutes before feeding, and almost all do so for 30–60 minutes after feeding. In the first experiment, parts of three walls of the house were divided into small areas of which some were treated with 5 per cent. DDT in kerosene, some were treated with kerosene alone and some were left untreated. The behaviour of individual fed and unfed females was watched throughout the night over a period of six months. Both DDT and kerosene exerted a repellent effect for 3–4 months. Mosquitos tended to move away from areas treated with either substance and to remain on untreated ones, and

the period of rest on treated areas was considerably shortened. Kerosene appeared also to produce an abnormal timing of the feeding-cycle during the night. In the second experiment, a 2 per cent. suspension of DDT from a water-dispersible powder was applied to the entire wall surface to give a deposit of 250–300 mg. per sq. ft. Some mosquitos were killed, some were driven out before they fed, and some fed without resting or rested only before or only after feeding, but reduction in the mosquito population and technical difficulties invalidated estimates of mortality. Most of the females remaining in the house were very restless, and many showed tremors characteristic of DDT poisoning. The behaviour of all showed deviations from the normal.

It is uncertain whether the reduced contact with DDT is enough to cause a useful mortality, but it was evident that little or no protection was given from attack. The effects of both DDT and kerosene are true repellencies [*cf.* **35** 108], though they may perhaps be better described as activation, which stimulates the mosquito to proceed immediately to the next operation in its sequence of activities so that it bites if unfed or flies out of the house if fed.

Wharton (R. H.). **The Habits of Adult Mosquitoes in Malaya. III. Feeding Preferences of Anophelines.**—*Ann. trop. Med. Parasit.* **47** no. 3 pp. 272–284, 41 refs. Liverpool, 1953. **IV. Swarming of Anophelines in Nature.**—*T.c.* pp. 285–290, 1 map, 7 refs.

The following paragraphs are substantially the author's summaries of these two papers, which belong to a series [*cf. R.A.E.*, B **41** 162].

Records of previous investigations of the feeding preferences of Malayan Anophelines are critically examined, and it is concluded that they do not justify the common view that *Anopheles maculatus* Theo. is anthropophilous in Malaya. The results of precipitin tests on the blood in Anophelines caught resting in various places are recorded, to show how such results depend on the situation in which the Anophelines are taken. Precipitin tests on Anophelines caught resting out of doors by day on a rubber estate where the mosquitos have an opportunity of feeding on man, cattle, dogs or fowls, combined with previously published results of experiments with various animals in window-trap huts [*loc. cit.*], are considered to give a fair picture of Anopheline feeding preferences. They show that all the Anophelines in the area, *A. maculatus*, *A. aconitus* Dön., *A. philippinensis* Ludl., *A. kochi* Dön., mosquitos of the complex of *A. hyrcanus* (Pall.) (mainly *indiensis* Theo. [**41** 116]), *A. vagus* Dön., the light-winged form of *A. barbirostris* Wulp [**34** 32], *A. karwari* (James) and *A. tesselatus* Theo., prefer cattle to any other animal, but that *A. maculatus* bites man much more readily than the other species (and hence shows a relative preference for man), that it will go indoors to do so, and that many females continue to feed on man despite the presence of cattle. The reasons why *A. maculatus*, *A. philippinensis*, *A. aconitus*, *A. kochi* and members of the complexes of *A. leucosphyrus* Dön. [*cf.* **40** 141; **42** 145–6], *A. barbirostris* [**34** 32] and *A. hyrcanus* [**41** 116–117] are malaria vectors in some areas and not in others are discussed, with particular emphasis on the part played by *A. maculatus* in Malaya.

Swarms of *A. philippinensis*, *A. h. indiensis*, *A. vagus*, *A. kochi* and *A. maculatus* were observed in nature at Tampin, Negri Sembilan, Malaya. The swarms consisted entirely of males. All swarming areas were relatively open, with no overhead obstructions, and were surrounded by trees or other objects. Swarms of *A. philippinensis* and *A. vagus* were 4–8 and 10–12 ft., respectively, from the ground and not related to any object on it; those of

A. h. indiensis were 1–2 ft. above a flower-bed or shrub; those of *A. kochi* were 4–6 ft. over the head of an observer; and those of *A. maculatus* were 15–20 ft. from the ground in an open clearing on a rubber estate. Swarming of *A. philippinensis* usually began about five minutes after sunset on clear evenings (light intensity 3–15 foot-lamberts) and continued until darkness fell about 20 minutes later. On dull evenings, swarming began earlier. *A. h. indiensis* began to swarm about ten minutes before darkness fell (light intensity less than 2 foot-lamberts). Swarming did not appear to be greatly influenced by meteorological conditions, but was disturbed by strong wind. Mating pairs were observed and caught near swarms of *A. philippinensis*. *Culex vishnui* Theo. and Chironomids were often seen swarming over the observer's head in the same area as the Anophelines.

Lavoipierre (M. M. J.) & Reynaud (P.). **A simple Way of counting Mosquito Eggs.**—*Ann. trop. Med. Parasit.* **47** no. 3 pp. 307–308, 2 figs., 2 refs. Liverpool, 1953.

Eggs of *Aëdes* or *Anopheles*, which are deposited singly, can be counted quickly and accurately by lightly laying a small piece of white writing paper for a moment on the surface of the water on which they are floating and removing it with the eggs adhering to it. A strip of paper about an inch wide is used, folded at a right angle to give a five-inch handle and a collecting area of about one inch square. With the paper held in the left hand and a pointer in the right, the eggs can be counted easily. The collecting area of paper should be increased if the density of eggs to be counted is very low or decreased if it is very high. The bowls of water on which the eggs are to be counted should be removed from the oviposition cages and exposed to light for at least 1½ hours, as the newly deposited eggs are white and do not show against the paper.

Nicholas (W. L.). **The Dispersal of *Culicoides grahamii* and *C. austeni* from their Breeding-sites prior to their taking a Blood-meal.**—*Ann. trop. Med. Parasit.* **47** no. 3 pp. 309–323, 1 pl., 8 figs., 10 refs. Liverpool, 1953.

The following is the author's summary. A study was made in the British Cameroons of the rate of decrease in the biting density of *Culicoides grahamii* Aust. and of *C. austeni* C., I. & M. with increasing distance from their breeding-sites. The investigation was limited to the biting density in clearings adjacent to the known breeding-sites of both species in the abundant rotting vegetation found in plantain and banana plantations. It is believed that the dispersal of the flies across such clearings is similar to that which takes places in African villages and European stations in the region. Estimates of the biting density were obtained from collections made by fly-boys within the breeding-sites and at various distances from them. In the case of *C. grahamii*, there appeared to be a linear relationship between the log of the biting density and the distance from a breeding-site. The regression of log biting density on distance, calculated from the results of experiments made on three successive days at one place, indicated that the biting density fell to 1/10 of its initial value at a distance of 370 yards, with approximately 95 per cent. confidence limits of 250 and 700 yards. The results of one day's work at another place indicated a somewhat more rapid fall. The maximum distance from the breeding-site at which *C. grahamii* was observed to bite was 400 yards, the greatest distance at which collections were made. The results of experiments on *C. austeni* were

much more limited, owing to unexpectedly low biting densities, which were probably due to the onset of the dry season. The fly was observed biting, however, at distances of up to 400 yards from the nearest breeding-site, the greatest distance at which collections were made. Reasons are given for suggesting that the dispersal of *C. grahamii* in forest may be radically different from its dispersal in clearings.

Macdonald (E. M.) & Scott (J. A.). **Methods for feeding Tropical Rat Mites on Blood and other Fluids through a Membrane.**—*Exp. Parasit.* **1** no. 3 pp. 283–290, 1 fig., 4 refs. New York, N.Y., 1952.

The following is largely the authors' summary. A method for feeding adults and protonymphs of *Bdellonyssus bacoti* (Hirst) through a membrane is described. The thin portions of baby chick skin were the most easily obtainable, but several other fresh animal membranes were equally satisfactory. The mites accepted whole blood from several species of animals equally well, and accepted diluted blood and plasma nearly as well as whole blood. Development of *Litomosoides carinii* in those fed on fresh blood of a cotton rat [*Sigmodon hispidus*] containing the microfilariae appeared to be normal.

Davis (G. E.). **The Relapsing Fevers: Tick-Spirochete Specificity Studies.** —*Exp. Parasit.* **1** no. 4 pp. 406–410, 8 refs. New York, N.Y., 1952.

Ornithodoros turicata (Dugès) and *O. talaje* (Guér.), *O. erraticus* (Lucas) and *O. normandi* Larrousse, and *O. talaje* and *O. rudis* Karsch represent pairs of ticks that at times occupy the same habitat and presumably feed on the same host. In the experiments described, *O. talaje* from Guatemala transmitted spirochaetes recovered from the same species from Texas, whereas *O. turicata* belonging to a strain from New Mexico and *O. rudis* from Ecuador did not. Similarly, the New Mexico strain of *O. turicata* transmitted spirochaetes recovered from the same species from Texas whereas *O. talaje* from Guatemala did not, and *O. erraticus* from Morocco transmitted spirochaetes from the same species also from Morocco, but *O. normandi* from Tunisia failed to do so.

Lachmajer [Lachmajerowa] (J.) & Kawecki (Z.). **Szczepy wirusów neurotropowych izolowane z kleszczy** *Ixodes ricinus* **na wybrzeżu.** [Strains of neurotropic Viruses isolated from Ticks, *I. ricinus*, on the Coast.]—*Bull. Inst. mar. trop. Med. Gdansk* **5** (1953) pp. 49–50. Warsaw, 1954. (Also in Russian and English, pp. 50–53.)

To ascertain whether natural foci [*cf. R.A.E.*, B **37** 18] of virus diseases transmitted by *Ixodes ricinus* (L.) occur in the coastal zone of Poland, 6,000 examples of this tick were collected from cattle in ten villages in the Province of Danzig, and suspensions of batches of 50 of those that were not fully engorged were injected intracerebrally into mice or used to inoculate chick embryos. The embryo tests were negative, but two strains of virus were isolated in the mice. Further tests showed that they differed in virulence to mice and caused no symptoms in guineapigs or rabbits. Intracerebral injection of the more virulent strain caused paralysis and death of practically all the mice used; intraperitoneal inoculation caused about 30 per cent. mortality after a longer incubation period. The other strain did not cause complete mortality or any paralysis by either method of inoculation.

Piątkowska (W.) & Skierska (B.). **Skład jakościowy oraz ilościowe wahania sezonowe muchówek na terenie Gdańska w roku 1951.** [The qualitative Composition and quantitative seasonal Fluctuations of Flies in the Territory of Danzig in the Year 1951.]—*Bull. Inst. mar. trop. Med. Gdansk* **5** (1953) pp. 237–254, 1 fig., 7 graphs, 16 refs. Warsaw, 1954. (With Summaries in Russian and English.)

A survey of flies associated with man was carried out from 1st April to 1st October 1951 in five different parts of the city of Danzig, of which three were on or close to the sea shore and two were inland. Over 15 thousand flies were caught on fly-papers, which were hung in inhabited buildings, chiefly in kitchens, and were changed once a week, and nearly 17 thousand in traps baited with decaying fish and beer, which were placed once a week for one hour in the morning in the yards of the buildings close to refuse boxes.

Of the flies caught in the traps, over 86 per cent. were blowflies (Calliphorids) and over 57 per cent. were *Phormia* (*Boreëllus*) *terraenovae* R.-D. The flies were first trapped in the third week of April, when the temperature was over 10°C. [50°F.], and were most abundant in the middle fortnight of July, when the mean temperature and saturation deficit were highest. Their numbers then fluctuated considerably, but declined from the second week in September, at temperatures of about 15°C. [59°F.]. *Musca domestica* L. and *Fannia canicularis* (L.) made up about 57 and 19 per cent. of the catch on the fly-papers, which included very few blowflies. The flies were first caught at the beginning of April. Their numbers rose considerably in May, June and July, but did not reach a maximum until the second half of August and then fell sharply.

The numbers of flies, both in and outside buildings, were much greater in the inland parts of the city, which were densely populated, than in those near the sea, which were not, and much greater in the kitchens and yards of communal eating places than in those of private dwellings.

The curves showing the incidence of typhoid and paratyphoid and of summer diarrhoea in children both reached peaks in August, during and just after the periods of maximum abundance of the flies in the buildings, and it is concluded that the latter are concerned in the spread of the summer diarrhoea, but that the flies that frequent the refuse boxes and were most abundant about a month before, are of greater importance in the epidemics of typhoid and paratyphoid, in view of the longer incubation period of these fevers.

Dicke (R. J.). **Fly Control on Dairy Farms. Resistance to Insecticides less important as Fly Control Factor than poor Sanitation.**—*Soap & chem. Spec.* **30** no. 5 pp. 177, 179, 183. New York, N.Y., 1954.

An account is given of observations on 29 dairy farms in three counties in Wisconsin in 1953 to find whether failures to control house-flies [*Musca domestica* L.] were due to poor sanitation or to resistance of the flies to insecticides. One of the farms, on which sanitation was good, had no insecticide treatment, and all but one of the others were treated with methoxy-DDT (methoxychlor). Additional insecticides, including γ BHC as lindane, were used on some, but there was no evidence that they affected the results obtained. The farms differed widely in respect of sanitation and the degree of resistance of the flies to methoxy-DDT and lindane. Control was estimated from the number of flies caught per sweep over an area where populations were greatest and was classed as satisfactory if the number was 0–2, fair if it was 3–9 and a failure if it was larger. The results for 28 farms showed satisfactory control on 15, including the one

not treated with insecticides, fair control on six and failure on seven. Sanitation was poor (manure not removed weekly from stock pens or yard and fly breeding extensive throughout summer) on all farms on which control failed, and fair (sporadically extensive breeding) on all farms on which control also was only fair. It was fair on two of the farms on which control was satisfactory, poor in a pig yard adjacent to a third and good in all the others. On the remaining farm, which was large, control was fair in the heifer barn and satisfactory in the dairy and stock barns, although these were open to fly invasion from a pig barn where breeding was extensive and control poor.

There appeared to be no correlation between the degree of control obtained and the relative tolerance of flies for methoxy-DDT. Control was satisfactory on two farms on which fly strains were relatively resistant and not on three on which they were relatively susceptible. Three extremely resistant strains were recovered, one each from farms on which control was satisfactory, fair and poor. It is concluded that effective control cannot be obtained with insecticides alone. Adequate sanitation is essential.

Moore (D. H.), Dove (W. E.) & Dickinson (B. C.). **Fly Control on Livestock.**—*Agric. Chem.* **9** no. 8 pp. 31–34, 109, 111, 113, 115, 117, 23 refs. Baltimore, Md., 1954.

The following is largely based on the authors' summary. Data obtained in Maryland over a period of several years are given, showing the effectiveness of various formulations of piperonyl butoxide in combination with pyrethrins, allethrin or both in protecting cattle against horn-flies [*Siphona irritans* (L.)], stable flies [*Stomoxys calcitrans* (L.)], Tabanids and in some instances house-flies [*Musca domestica* L.].

Sprays of wettable powders containing 10 per cent. piperonyl butoxide and 0·75–1 per cent. pyrethrins, diluted at rates of 20–30 lb. per 100 U.S. gals. and applied to the point of run-off, formed deposits that gave protection against moderate and usual numbers of *Siphona* for 7–12 days. At dilutions of 1:9 or 1:19, emulsion concentrates containing 10 gm. piperonyl butoxide and 1 gm. pyrethrins made up to 100 ml. with emulsifier and odourless base oil gave excellent protection against *Siphona* for 5–12 days, mainly according to initial populations. The 1:9 dilution also gave good protection against rather high populations of *Stomoxys* for 1–2 days and from *Tabanus atratus* F. for three days or more. It also gave partial protection from each for a few additional days. When allethrin was substituted for the pyrethrins and piperonyl butoxide was maintained at the same concentrations in both sprays, about twice as much allethrin was needed to maintain comparable protection against *Siphona*, *Stomoxys* and Tabanids.

Several gas-propelled sprays containing pyrethrins or allethrin in combination with piperonyl butoxide and methoxy-DDT (methoxychlor) and in some cases another insecticide were applied at rates varying from 2 to 6 gm. per animal. The propellent was usually a mixture of equal parts of Freon 11 [trichlorofluoromethane] and Freon 12 [dichlorodifluoromethane], and the nozzle of the container was held about 18 ins. from the animal. Good protection against *Siphona* was obtained for six hours after treatment, with noticeable reductions in the visiting populations even up to 12 hours. These same formulae effectively reduced moderate numbers of visiting house-flies and stable flies for up to four hours after treatment.

Lewis (D. J.). **Simuliidae in the Anglo-Egyptian Sudan.**—*Rev. Zool. Bot. afr.* **48** fasc. 3–4 pp. 269–286, 17 figs., 17 refs. Brussels, 1953.

Additional work on the Simuliids of the Sudan [*cf. R.A.E.*, B **39** 178] has shown that 22 species and two varieties (all of the genus *Simulium*)

occur there. Their distribution is recorded and observations on structures of the early stages in relation to types of breeding place are dicussed.

Ovazza (M.). **L'onchocercose humaine et son aspect entomologique dans le sud de l'A. E. F.**—*Bull. Soc. Path. exot.* **46** no. 4 pp. 575–586, 1 fldg. map, 18 refs. Paris, 1953.

Onchocerca volvulus has long been known to occur in man in French Equatorial Africa in the Gabon [*R.A.E.*, B **20** 102] and along the Congo and its tributaries below Brazzaville, and *Simulium damnosum* Theo. is probably the only vector there. Some early literature on the subject is briefly reviewed, and an account is given of a survey carried out from December 1949 to June 1952 to determine the distribution of *S. damnosum* between these two areas, in which it was known to be present, and to the north of Brazzaville. The country in which the survey was made is described. The only Simuliids found attacking man were *S. damnosum* and *S. albivirgulatum* Wanson & Henrard [*cf.* **41** 201], though larvae of others were plentiful. *S. damnosum* was found in much of the territory between the known foci to the north-west and west of Brazzaville. *S. albivirgulatum* was also found over a very wide area, breeding in large rivers and quite small streams north and north-east of Brazzaville. It was not found in the Congo itself but was present as far as the junction in some rivers flowing into it. The areas of distribution of the two species were quite distinct, *S. damnosum* occurring in the western savannah and forest and *S. albivirgulatum* in the sandy area to the east. The limit is very clear-cut and corresponds with that of the sand. On the Congo, it occurs at Brazzaville itself.

The rivers in which the two species bred differed in their rate of flow, but this did not appear to be a sufficient explanation of the difference in distribution. Neither species colonised breeding places suitable for it if they were in the territory of the other, though they sometimes existed within its flight-range. It is thought that adult ecology was responsible. Of 724 individuals of *S. damnosum* caught on the Djoué above Brazzaville, 23 contained infective filariae in the proboscis and 59 contained sausage-stage larvae. On the other hand, of nearly 1,000 of *S. albivirgulatum* from three areas, none had filariae [*cf.* **36** 148].

Onchocercosis in man is thought to extend far beyond the limits of the well-known foci. It was widespread in the area occupied by *S. damnosum* but was not found in the area occupied by *S. albivirgulatum*. It is concluded that it would be impossible to eradicate *S. damnosum* as a means of protecting Brazzaville. Only the formation of a protective barrier would be practicable. Brazzaville itself is largely outside the onchocercosis zone. It is built on sand hills and *S. damnosum* seldom enters it.

Roubaud (E.). **Fluctuations spontanées dans la dispersion des culicides, observées dans la Vendée côtière depuis l'occupation allemande. Interprétation du problème.**—*Bull. Soc. Path. exot.* **46** no. 4 pp. 595–604, 10 refs. Paris, 1953.

The author's observations on Anophelines in France have included some (interrupted during the war) in an area on the Vendée coast. The only biotype of *Anopheles maculipennis* Mg. found there up to 1939 was *atroparvus* van Thiel, but another, which laid barred eggs like those of *messeae* Flni. was observed in 1946 and subsequent years. Adults of the two biotypes were often found in approximately equal proportions in the same

catching stations (animal shelters), but their breeding places were quite distinct. Evidence that crossing between them had occurred was afforded by abnormalities in the characters of the eggs laid by some of the females; larvae hatched from such eggs and some reached the fourth instar, but none gave rise to adults [*cf. R.A.E.*, B **27** 158]. Some of the eggs in batches otherwise characteristic of *messeae* had the characters of *A. m. typicus*, though no pure batch of *typicus* eggs was ever found in the region, and other eggs had those of the natural *typicus-atroparvus* hybrids of Normandy [**25** 276–277]. It is concluded that the *messeae*-like biotype was not genetically pure, but consisted of a hybrid *messeae-typicus* population.

No change in the character of the available breeding places had occurred that would account for the establishment of such a population in the coastal area, but there were two changes in local conditions acting on the adults. The first was a sudden and great increase in the human and equine population during the German occupation, which provided abundant food supplies and thus encouraged infiltration. The second was a great increase in the permanent population of the area and corresponding increase and improvement in buildings. This provided abundant shelters with the cool conditions required by hibernating females of *messeae* and *typicus*.

Holstein (M.). **Enquêtes épidémiologiques sur le paludisme dans le cercle de Bobo-Dioulasso (Haute-Volta, 1949–1950).**—*Acta trop.* **10** no. 2 pp. 113–125, 7 refs. Basle, 1953. (With Summaries in English and German.)

On the basis of 56 malaria surveys made between 1st August 1949 and 30th June 1950, the Bobo-Dioulasso region of French West Africa [*cf. R.A.E.*, B **41** 144] is classed as meso-endemic, with several centres of hyperendemicity. The vectors are *Anopheles funestus* Giles, *A. gambiae* Giles and *A. rufipes* (Gough) [*cf.* **41** 145, 181]; the sporozoite indices of these species for the region as a whole, and (in brackets) the average number of females of each per hut were, respectively, 7·1 (1·41), 9·2 (0·5) and 7·8 (0·37).

Thurman jr. (D. C.). *Ayurakitia*, **a new Genus of Mosquito from northern Thailand (Diptera: Culicidae).**—*J. Wash. Acad. Sci.* **44** no. 6 pp. 197–200, 1 fig., 3 refs. Baltimore, Md., 1954.

Ayurakitia, gen.n., is erected for *A. griffithi*, sp.n., both sexes of which are described from Siam. The males are similar in general appearance to those of *Aëdes*, but differ morphologically in lacking postspiracular bristles. This difference might not be considered of generic value, since the subgenus *Kompia* of *Aëdes* [*R.A.E.*, B **29** 184] was erected for females without these bristles, but the new species differs in certain characters of the females from any of the subgenera of *Aëdes* now recognised.

Deane (L. M.), Damasceno (R. G.) & Arouck (R.). **Distribuição vertical de mosquitos em uma floresta dos arredores de Belém, Pará.** [Vertical Distribution of Mosquitos in a Forest near Belém, Pará.]—*Folia clin. biol.* **20** no. 2 pp. 101–107, 2 pls., 13 refs. São Paulo, 1953.

The results are given of an investigation carried out from May 1947 to June 1949 in a forest near the city of Belém in the State of Pará, Brazil,

and surrounding a reservoir which is the principal local breeding place of *Anopheles darlingi* Root. The trees were about 30 metres [100 ft.] high and platforms 5, 10 and 15 metres above ground level were set up among them. Mosquitos coming to men on the ground and on the platforms were collected simultaneously once or twice a week; the collecting periods lasted six hours and were timed to include all hours of the day and night. Nearly 13,000 females of about 60 species of mosquitos were taken, but only 17 species were in large enough numbers (50 or more) for their vertical distribution to be studied. The percentages taken at ground level and at 5, 10 and 15 metres were 50·6, 18·2, 19·4 and 11·8 for *A. darlingi*, 3·3, 5·6, 29·4 and 61·7 for *A. mediopunctatus* (Theo.) and 4, 7·3, 24·6 and 64·1 for *A. shannoni* Davis. The definite preference shown by the last two Anophelines for the highest platform, although their larvae occur in ground pools or rivers, may explain why adults are usually much rarer than larvae in material collected in routine surveys. As considerable numbers of *A. darlingi* were feeding at high levels, it is likely that it sometimes feeds on arboreal animals and that sporozoites found in it may be *Plasmodium brasilianum*, a malaria parasite of monkeys known to develop in *A. albimanus* Wied. and *A. aquasalis* Curry. Of the other mosquitos, some preferred the ground or the platforms and some showed no marked preferences; the percentages on the ground and the highest platform were about 50 and 24 for *Aëdes scapularis* (Rond.) and *A. serratus* (Theo.) and 8·7 and 26·1 for *Haemagogus spegazzinii* Brèthes.

Durand-Delacre (R.) & Mémin (Y.). **Les phlébotomes des terriers de rongeurs sauvages au Sahara.**—*Arch. Inst. Pasteur Algér.* **31** no. 3 pp. 320–333, 2 pls., 2 maps, 5 refs. Algiers, 1953.

Collections of *Phlebotomus* were made during the hot season in 1951 and 1952 in burrows of rodents near Beni Ounif-de-Figuig in the Algerian Sahara [*cf. R.A.E.*, B **40** 21]. Some of the burrows had been abandoned by the rodents and were empty or were being used as shelter by snakes, lizards or toads. It was regularly observed that the sandflies were abundant in burrows near oases, where species that bite man and warm-blooded animals (*Phlebotomus papatasi* (Scop.), *P. sergenti* Parr., *P. alexandri* Sinton and *P. clydei* Sinton) predominated. Species that feed on reptiles (*P. minutus parroti* Adl. & Thdr. and *P. fallax* Parr.) were generally distributed and predominated in desert areas. The sandflies apparently entered the burrows for shelter only, as males were more numerous than females and the presence or absence of rodents or other animals in the burrows did not appreciably influence the abundance or species composition of the sandfly fauna. The warmest and most sheltered burrows were the most frequented.

Distribution of Tsetse Species in Africa.—D.C.S. (Misc.) Map 48a–c (sheets 1–3). London, Dir. colon. Surv., 1953–54. (For sale by E. Stanford, Ltd. Price 4*s.* 6*d.* each sheet.)

A map of the whole of Africa south of latitude 16°N. and west of longitude 46°E. is printed on three sheets. The mean scale is 1:5,000,000. The distribution of each of the 20 species of *Glossina* is shown on it by symbols (for isolated records) and colours (for large belts). Country thought to contain tsetse but in which the species is unknown, and country known to be tsetse-free are also shown. The map was drawn from information collated by W. H. Potts and supplied by the various territorial organisations

concerned through the International Scientific Committee for Trypanosomiasis Research. Sheets 1 and 2 comprise the parts of the continent west and east, respectively, of 14°E. and north of 4°N., and sheet 2 also includes the sites of ancient records of *G. tachinoides* Westw. in Arabia and has an extension to cover the area of Africa south of 4°N. and east of 42°E. Sheet 3 comprises the part south of 5°N. and west of 42°E.

BLANTON (F. S.). **Toxicity of several new organic Insecticides to Body Lice** (*Pediculus humanus corporis* **DeG.**).—*J. N. Y. ent. Soc.* **61** nos. 3–4 pp. 169–180, 217–235, 80 refs. Lancaster, Pa., 1953[–54].

The literature on the control of *Pediculus humanus humanus* L. (*P. h. corporis* Deg.) published since the period covered by the bibliography of Grinnell & Hawes [*R.A.E.*, B **31** 212] is reviewed. In an endeavour to find compounds more effective against it than DDT, over 10,000 were subjected to screening by beaker tests [**34** 44–45], and 106 found to give 100 per cent. kill of adults in 24 hours for 31 days or more at 10,000 parts per million were chosen for further study at successively higher dilutions. Data are given on the 13 found to be worth detailed study, and the following is largely based on the author's summary of them. DDT was inferior to the other 12 at 100 p.p.m. and to eight at 50 p.p.m. Parathion gave complete kill at 12·5 p.p.m., heptachlor and dieldrin at 6·25 p.p.m., and aldrin at 3·125 p.p.m. Beaker tests of the duration of effectiveness of the 13 more promising materials were made by exposing fresh batches of lice on successive days. At 50 p.p.m., DDT gave 50 per cent. kill on the first day and none thereafter, and the other 12 were still effective after one day. The most durable were parathion and dieldrin, which gave complete kill for eight and five days, respectively, at 12·5 p.p.m.

All the insecticides that had shown promise in the beaker tests were tried in powders. The powder was prepared by impregnating a diluent with an acetone solution of the chemical, and 1 gm. was spread on a piece of cotton cloth about 5 ins. square. The piece of cloth was placed on a plywood board, and young adult lice were confined on it under an inverted petri dish. Of 15 diluents tested alone, eight, including pyrophyllite, had a definite lethal effect. Pyrophyllite was chosen for further comparative tests together with gypsum, Dilroc, Frianite and walnut shell flour, which did not harm the lice. Pyrophyllite alone and in combination with Frianite caused considerable mortality, whereas gypsum and Dilroc alone and in combination with Frianite caused little or none. At low concentrations of insecticide, walnut shell flour combined with the diluents that were lethal caused a marked decrease in the effectiveness of each insecticide. In dust tests with gypsum, several insecticides were better than DDT at 500 p.p.m., but some of them were not effective at lower concentrations. Heptachlor, dieldrin, γ BHC as lindane, parathion, aldrin and chlordane were outstanding. At 50 p.p.m., they gave 100, 100, 100, 97, 95 and 70 per cent. mortality, respectively, whereas DDT caused no mortality at this concentration and only 12 per cent. at 500 p.p.m.

The fumigant effect of the chemicals was tested by exposing lice in jars to the fumes from woollen pads impregnated with 1 per cent. solutions (10,000 p.p.m.). Those that were effective were further diluted and tested again. Tetraethyl dithiopyrophosphate (which was not among the 13 retained in the beaker tests), aldrin, heptachlor, chlordane, lindane and dieldrin gave 100, 83, 80, 50, 27 and 17 per cent. mortality, respectively, at a solution concentration of 100 p.p.m., and 93, 30, 30, 5, 0 and 0 per cent. mortality at 50 p.p.m.

Heisch (R. B.). *Ornithodoros erraticus* (Lucas) **in Ant-chat Burrows.**—*E. Afr. med. J.* **31** no. 6 p. 264, 1 ref. Nairobi, 1954.

The finding of larvae, young nymphs and adults of *Ornithodoros erraticus* (Lucas) in burrows of ant-chats (*Myrmecocichla* sp.) in Kenya is recorded. The ticks were morphologically indistinguishable from the form associated with pygmy gerbils (*Dipodillus* sp.) [*cf. R.A.E.*, B **42** 17–18]. Several were tested for the presence of spirochaetes [*cf.* **41** 9], but all were negative.

Berge (T. O.) & Lennette (E. H.). **World Distribution of Q Fever: Human, Animal and Arthropod Infection.**—*Amer. J. Hyg.* **57** no. 2 pp. 125–143, 1 map, 183 refs. Baltimore, Md., 1953.

It is shown by this review of the literature that Q fever or its causative agent (*Coxiella burneti*) has been reported to occur in Australia, the United States, Panama, England, Wales, Italy, Sicily, Corsica, Spain, Portugal, Switzerland, France, Germany, Rumania, Yugoslavia, Greece, Turkey, Israel, Morocco, Algeria, Libya, the Belgian Congo, South Africa and China. Presumptive evidence of Q fever endemicity has been found in Mexico, French Equatorial Africa and perhaps Iraq and India. *Coxiella burneti* has been recovered from man, various ticks, cattle, sheep and goats in widely separated parts of the world, from *Pediculus humanus humanus* L. (*P. h. corporis* Deg.) in the Belgian Congo, the bandicoot, *Isoodon torosus*, in Australia and the gerbil, *Meriones shawi*, in Morocco, and from dust in the vicinity of cattle, sheep and goats in California.

Addison (C. C.) & Furmidge (C. G. L.). **Physicochemical Studies on the Application of Insecticides to Sheep Fleece. VI. Successive Treatment of Solutions of cationic Wetting Agents with natural Fleece under non-equilibrium Conditions.**—*J. Sci. Fd Agric.* **5** no. 9 pp. 440–444, 7 graphs, 2 refs. London, 1954.

The work described in previous papers of this series [*R.A.E.*, B **42** 183, etc.] was largely confined to a study of equilibrium states in the reaction between natural fleece and solutions of cationic wetting agents. When a wool sample is immersed in such a solution, equilibrium conditions are established within 30 minutes, and this period was used as a standard. The period of immersion in a dip, however, does not normally exceed one minute. In order to relate the conclusions already reached to actual dipping practice, non-equilibrium conditions were studied by ascertaining the variation of activation or inactivation of the wetting agents with period of immersion of the fleece sample, and the changes in interfacial activity of the solutions that result from treatment with successive samples of fleece for short periods (usually between one and five minutes).

It is concluded that the curves representing variation of activation or inactivation with time (0–30 minutes) can be classified into four clear types, according to the carbon-chain length and the halide ion of the wetting agent [*cf.* **42** 184]. The considerable inactivation that results from successive addition of fleece samples to solutions of octadecyl- and cetylpyridinium halides renders them undesirable for the formulation of dips. Tetradecylpyridinium compounds show only a slight improvement. By employing a cationic agent of still shorter chain-length and small halide ion (dodecylpyridinium chloride), the interfacial activity of the solution can be maintained at a reasonably high level during a series of fleece additions.

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Angelovski (T. P.). **Contribution to the Knowledge of the Fauna of Ticks in the People's Republic of Macedonia. I. The Tick Fauna of the District of Skopl'e.** [*In Serbian.*]—*Acta vet.* **4** fasc. 2 pp. 53–57, 8 refs. Belgrade, 1954. (With a Summary in French.)

Ticks collected from cattle in the district of Skopl'e during 1952 and 1953 comprised *Ixodes ricinus* (L.), *Haemaphysalis inermis* Bir., *Rhipicephalus bursa* C. & F., *R. sanguineus* (Latr.), *Boophilus calcaratus* (Bir.), *Dermacentor marginatus* (Sulz.) (*reticulatus*, auct.), *Hyalomma savignyi* (Gerv.) and *H. detritum* Schulze. *H. detritum* had not previously been definitely recorded from Macedonia, but is stated to be of importance there as it transmits *Theileria annulata* (*dispar*), which is fairly widely distributed in cattle in the republic. Tables show the percentages of the total numbers of ticks represented by the various species in each month from March to August in 1952 and April to September in 1953; *H. detritum* was found only in April 1952, when it represented 20 per cent. of the ticks.

Geigy (R.), Wagner (O.) & Aeschlimann (A.). **Transmission génitale de *Borrelia duttoni* chez *Ornithodorus moubata*.**—*Acta trop.* **11** no. 1 pp. 81–82, 4 refs. Basle, 1954.

The authors describe two experiments on the two kinds of genital transmission of *Spirochaeta* (*Borrelia*) *duttoni* theoretically possible in an infected strain of *Ornithodoros moubata* (Murr.), transovarian transmission and transmission from male to female during mating. Female ticks that had engorged on infected mice had spirochaetes in all the organs, including the uterus and oviducts and the follicular layer of the ovary, after 5–6 days, and spirochaetes had penetrated the ovules and lodged in the vitelline membrane. Eggs laid 4–15 days after the blood-meal contained spirochaetes, but there had apparently been very little increase in their numbers since the infection of the ovule. The ticks that hatched were examined when they were second-stage nymphs, and 40–60 per cent. of those from each batch of eggs contained spirochaetes distributed throughout the body. To test the possibility of transmission during copulation, 82 male ticks were fed on an infective mouse, allowed to pair with 108 females and then examined. The females were killed and examined immediately after pairing or 5–28 days later. As the testicular tubes and spermatophore glands bore many spirochaetes, it was anticipated that the spermatophore would also contain them and transfer them to the females, but no spirochaetes were found in the latter. It is concluded that *S. duttoni* is not transmitted from males to females of *O. moubata* during mating and that this is because the spirochaetes are retained on the testicular wall and by the layer of glandular cells which are very attractive to them.

Hopla (C. E.). **Experimental Studies on Tick Transmission of Tularemia Organisms.**—*Amer. J. Hyg.* **58** no. 1 pp. 101–118, 10 figs., 21 refs. Baltimore, Md., 1953.

The status of *Amblyomma americanum* (L.) as a vector of tularaemia has hitherto been uncertain [*cf. R.A.E.*, B **33** 23, 86], as it had not been found infected in nature, although the evidence that it was a likely vector was considerable. However, it is stated in a foot-note to this paper that *Bacterium tularense* has been isolated from *A. americanum* by the author working with C. M. Downs. Observations in the course of a study made in 1947–49 in an extensive area mainly in Oklahoma and Arkansas had

indicated that the tick was not host specific at any stage. This would suggest that it might be an efficient vector.

In the investigation that forms the subject of this paper, quantitative methods were used in an attempt to observe the changes that took place in infected individuals of *A. americanum* after prolonged starvation and after feeding on hosts of various types. The materials used and the methods of feeding and storing the ticks are described. The earlier observation that ticks infected as larvae retained the infection as nymphs and adults [**23** 141] when feeding upon susceptible hosts was confirmed. Ten adults all retained infection after fasting for six months, but the number of organisms per tick was considerably reduced. Ticks that had fasted for six months after reaching the adult stage transmitted infection to guineapigs as readily as those that had fasted for only two weeks. Titrations in mice indicated a slight loss of virulence on tick passage in the strain of *B. tularense* used, but it is questionable whether the decrease was significant. When infected individuals of *A. americanum* were fed on various recovered hosts (rabbit and rats) or on a resistant animal (dog), there was no change in the percentage of ticks infected and the number of organisms per tick showed a slight increase. This increase was, however, less than that observed when infected ticks were fed on susceptible hosts.

Feldman-Muhsam (B.). **On the Identity of *Rhipicephalus sanguineus* Lat.**—*Bull. Res. Coun. Israel* **2** no. 2 pp. 187–194, 8 figs., 21 refs. Jerusalem, 1952.

The author has found that the ticks hitherto identified as *Rhipicephalus sanguineus* (Latr.) comprise two species, indistinguishable in the adult stage by external macroscopic characters, but readily separated by the form of the female genital aperture, and easily distinguished also in the larval and nymphal stages. As the type of *R. sanguineus* cannot be located, and it is therefore impossible to know which of the two species is the true *sanguineus*, the tick most prevalent on dogs is so designated and the other is named *R. secundus*, sp. n. Both are described from laboratory-bred females, nymphs and larvae. No distinguishing characters have been found for the adult males. Examination of small collections of ticks from different parts of the world showed that both species are present among nine females from France and ten from Algeria, whereas four from Italy, five from Indonesia and 19 from various parts of the United States were all *R. sanguineus* [*cf.* also *R.A.E.*, B **43** 21].

Bernkopf (H.) & Levine (S.). **Isolation of a Virus closely related to West Nile Virus from the Blood of a sick Child during an Epidemic in Ma'ayan Tsevi.**—*Bull. Res. Coun. Israel* **2** no. 2 p. 209. Jerusalem, 1952.

Olejnik (E.). **Infectious Adenitis transmitted by *Culex molestus*.**—*T.c.* pp. 210–211.

In the first paper, an account is given of the isolation of a virus from the blood of a child suffering from a mild, febrile disease of which an epidemic occurred in both adults and children in a communal settlement near Haifa in the summer of 1951. The virus was pathogenic for mice, hamsters, field mice and developing chick embryo and was neutralised by antiserum against West Nile virus [*R.A.E.*, B **42** 165, etc.] and to a smaller degree by antisera against Japanese B encephalitis and St. Louis encephalitis. Immune mice were resistant to intracerebral infection with

at least 10^4 lethal doses of a strain of West Nile virus obtained from J. L. Melnick.

In the second paper, the symptoms are given of a mild febrile disease, clinically identical in the various localities and presumably caused by the same virus, of which epidemics occurred in Israel between July 1950 and August 1951 in army and immigrant camps and in the communal settlement near Haifa. It is thought that it was mosquito-borne because its incidence rose and declined with that of *Culex pipiens molestus* Forsk., the first cases in the settlement occurred amongst people living near breeding places of this mosquito, and the infection was not spread by close contact or prevented by strict quarantine and was apparently acquired at night. Moreover, strains of a virus isolated from patients' blood during the epidemic and from *C. p. molestus* in two places caused paralysis in suckling and adult mice. Females of this mosquito transmitted the virus from intracerebrally infected hamsters to healthy ones after intervals of 6, 14 and 20 days. It could be isolated from the hamsters thus infected and transferred to other hamsters and to mice.

Mazzotti (L.). **Sobre una nueva espiroqueta de la fiebre recurrente, encontrada en México.** [On a new Relapsing Fever Spirochaete found in Mexico.]—*Rev. Inst. Salub. Enferm. trop.* **10** no. 3 pp. 277–281, 2 refs. Mexico, D. F., 1949. (With a Summary in English.)

Davis (G. E.) & Mazzotti (L.). **The Nontransmission of the Relapsing Fever Spirochete, *Borrelia dugesii* (Mazzotti, 1949) by the Argasid Tick *Ornithodoros turicata* (Dugès, 1876).**—*J. Parasit.* **39** no. 6 pp. 663–666, 4 refs. Lancaster, Pa., 1953.

An account is given in the first paper of experiments on the identity of spirochaetes, morphologically resembling those of relapsing fever, that were found in 1946 in some examples of the Mexican tick, *Ornithodoros dugesi* Mazzotti [*R.A.E.*, B **32** 235], and were transmitted by the bite of this tick to various laboratory animals. The spirochaete was isolated in mice. Attempts to transmit it from the mice to uninfected animals by the bites of *O. parkeri* Cooley, *O. hermsi* Wheeler and *O. talaje* (Guér.) were negative, but similar experiments with *O. turicata* (Dugès) resulted in infection. A long series of experiments made to determine whether *Spirochaeta turicatae* could be transmitted by *O. dugesi* gave completely negative results. Thus it is shown that the spirochaete found in *O. dugesi* is distinct from the relapsing fever spirochaetes transmitted by the other four ticks used in the experiments and the name *S. dugesi* is proposed for it.

The following is substantially the authors' summary of the second paper. The report that *S.* (*Borrelia*) *dugesi* was transmitted by *O. turicata* as well as by *O. dugesi* constituted the first indication of a major break in the specific tick-spirochaete relationship in the Western Hemisphere [**31** 177]. In order that the senior author might study the matter further, the spirochaete thus transmitted was forwarded to him in *O. coriaceus* Koch, which did not transmit it by feeding and which has never been found to be infected with spirochaetes in nature. The ticks were triturated and the triturate was injected into two white mice, from which a strain was readily recovered. This strain was then studied by transmission experiments with *O. turicata* and *O. dugesi*, quantitative transovarial transmission in *O. turicata*, reciprocal cross-immunity tests, and comparative studies with a known Mexican strain of *O. turicata* and a strain of true *S. dugesi*, recovered by feeding *O. dugesi* on mice. By these methods, it was shown that the triturate strain was not *S. dugesi* but *S.* (*B.*) *turicatae*. When the true *S. dugesi* was tested for transmission by *O. turicata* and *O. dugesi*,

there was no transmission by *O. turicata*. It was concluded that the examples of *O. turicata* used in the original experiment were carrying spirochaetes of their own and that they had transmitted these instead of *S. dugesi*. The difficulty of maintaining a spirochaete-free stock of ticks is discussed.

Feldman-Muhsam (B.). **The Identity of *Rhipicephalus sanguineus* in the U.S.A.**—*J. Parasit.* **39** no. 6 p. 670. Lancaster, Pa., 1953.

The author refers to her recent differentiation of *Rhipicephalus secundus* Fel.-Muh. from *R. sanguineus* (Latr.) [*R.A.E.*, B **43** 19], and states that both species have been found to occur in Israel, Turkey, Yugoslavia, France, Algeria and Senegal. During a visit to the United States, she examined specimens from 17 States, including 42 females and many nymphs and larvae from dogs, five females from deer and one nymph from man and found all to be *R. sanguineus*.

Rendtorff (R. C.). **A Method of exposing Flies to infectious Material.**—*J. Parasit.* **39** no. 6 pp. 672–673, 1 fig. Lancaster, Pa., 1953.

A device that held house-flies [*Musca domestica* L.] so that they would feed on infectious material quickly and with minimum damage or exterior contamination is described. V-shaped notches were cut along one edge of a piece of thin stiff paper and the opposite edge was tacked to a small block of soft wood so that the notches extended horizontally when the block was placed on a table. Hungry flies were slipped with forceps into the notches so that their heads extended above and inward and their bodies below the paper. A small strip of cellophane tape was placed over the opening of the notch as a precaution against escape. A drop of infectious material near the edge of a cover slip was put near the mouth-parts of the flies, which fed readily. Nearly all flies held in this way would feed to repletion in 20 minutes, as compared with about 25 per cent. of flies free in a cage. After being fed, the flies were transferred to a cage, where they behaved normally.

Moores (H.). **A Method for maintaining a Colony of *Anopheles gambiae* in the Laboratory.**—*Trans. R. Soc. trop. Med. Hyg.* **47** no. 4 pp. 321–323, 2 refs. London, 1953.

The following is the author's summary. A colony of *Anopheles gambiae* Giles has been successfully maintained under laboratory conditions for over three years. The larvae are fed on a mixture of "Bemax", desiccated heart, liver extract and yeast, and the adults on man.

Goldwasser (R. A.) & Davies (A. M.). **Transmission of a West Nile-like Virus by *Aedes aegypti*.**—*Trans. R. Soc. trop. Med. Hyg.* **47** no. 4 pp. 336–337, 1 fig., 4 refs. London, 1953.

A technique by which a West Nile-like virus (Melnick's E.V. 101) was transmitted from and to embryonated hen's eggs by the bite of *Aëdes aegypti* (L.) was devised during a study of the mechanism of mosquito transmission of viruses suggested by the apparent importance of *Culex pipiens molestus* Forsk. in the transmission of a West Nile-like virus in Israel [*R.A.E.*, B **43** 19]. Embryonated eggs 10–11 days old were infected with a mouse-brain virus preparation by inoculation into the chorioallantoic sac. After 48 hours, the shell overlying the air sac was cut away and air

under slight pressure was introduced through the opening used for inoculation, until the membranes underlying the air sac bulged slightly through the open end of the egg. The hole through which the air had been introduced was then sealed with paraffin wax. The egg was placed in a small wooden incubator with a hole in the bottom through which the opened end of the egg protruded. The temperature round the egg was kept at 39 ± 1°C. [102·2 ± 1·8°F.] by an electric bulb. About 50 females of *A. aegypti* that had emerged 10–14 days before were put in a small plastic box with a hole in the lid covered by gauze mosquito-netting. A beaker fixed to the bottom of the container could be filled with water through the netting with a hypodermic syringe. The open end of the egg was rested on the gauze in a room with a temperature of 28°C. [82·4°F.] so that the mosquitos could feed on it. About 80–90 per cent. of them usually did so within 20 minutes provided that the temperature of the egg was not allowed to fall below 36°C. [96·8°F.]. After engorgement, the mosquitos were immobilised by cooling and unfed ones were removed. The others were kept in the box at 28–30°C. [82·4–86°F.] at a relative humidity of 70–80 per cent. and provided with water and honey. Immediately after the mosquitos had fed, the egg was removed and bled, and the blood was diluted and injected intracerebrally into mice to confirm the presence of virus.

Transmission experiments were made in the same way, by putting either an immobilised hamster or young mouse or the open end of a 10-day old embryonated egg in contact with the gauze of the cage containing the infected mosquitos. After the mosquitos had fed, the end of the egg was closed with cellophane tape, 100 units of penicillin were introduced and the egg was incubated for 48 hours at 37°C. [98·6°F.]. The presence of virus in the egg was then demonstrated as before. Transmission was effected in ten out of 16 attempts and by the bites of 2–12 females. The mosquitos could transmit infection from the sixth until at least the 28th day after engorgement.

Lee (R. D.). **Oviposition by the Poultry Bug.**—*J. econ. Ent.* **47** no. 2 pp. 224–226, 3 refs. Menasha, Wis., 1954.

Populations of *Haematosiphon inodorus* (Dugès), a pest of poultry in the south-western United States, may reach large proportions in a relatively short time. To obtain some knowledge of its potential rate of increase, the oviposition habits of the bug were studied. Records are given of the number of eggs laid by 15 paired females, and counted every two days for 30 days, and of the day of death of all the females except the one that survived the period. The females were given opportunities to feed every few days. All began to oviposit within ten days of pairing, and the average number of eggs laid per female was 33. Nymphs hatched from 72 of 76 eggs used for life-history studies, and 41 of them gave rise to adults. When 14 unfed females were caged with 14 unfed males, 12 eggs were laid, of which ten hatched. Eight females that were allowed to feed but not to pair did not oviposit during the 25 days of the experiment. After this, the seven that survived were allowed to pair and all oviposited.

Packchanian (A.). **Altitude Tolerance of normal and infected Insects.**—*J. econ. Ent.* **47** no. 2 pp. 230–238, 1 fig., 14 refs. Menasha, Wis., 1954.

The following is substantially the author's summary. A new apparatus, combining a refrigeration unit with a low-pressure chamber, is being used

for experiments at Galveston, Texas. It is convenient for studying the effects of low temperatures and atmospheric pressures on small mammals, insects and micro-organisms and for simulating the conditions of low temperature and pressure existing at various altitudes. The chamber has a working space of 12 × 12 × 12 ins., and any temperature ranging from 25°C. [77°F.] to −85°C. [−121°F.] can be maintained within it. Atmospheric pressures as high as 1,320 and as low as 10 mm. mercury can be maintained indefinitely, concurrently with or independently of the temperature within the chamber.

Adults of *Aëdes aegypti* (L.), *Bdellonyssus bacoti* (Hirst), *Culex pipiens fatigans* Wied. (*C. quinquefasciatus*, auct.), *Musca domestica* L. and nymphs and adults of *Triatoma gerstaeckeri* (Stål) were exposed for different periods to the conditions of temperature and pressure corresponding to various altitudes. All were killed within four hours at −15°C. [5°F.] with an atmospheric pressure of 429 mm. (conditions corresponding to an altitude of 15,000 ft. above sea level). Virtually all those exposed for 16 hours at −5°C. [23°F.] with a pressure of 522 mm. (conditions corresponding to an altitude of 10,000 ft.) survived and resumed their normal activities, and many survived longer exposures. The survival and death curves in which time is plotted against temperature are essentially similar for all species studied. In all cases, a sharp inflection in the curve was noted between −10°C. [14°F.] and −15°C. The conditions of low temperature and pressure that were just below the level of severity necessary to cause death produced permanent paralysis of some of the insects exposed, notably of *T. gerstaeckeri*. These paralysed insects could not feed on experimental animals.

All of 24 individuals of *T. gerstaeckeri* that were exposed for 24 hours at 25°C. to a pressure 20 in. below atmospheric pressure were uninjured and resumed their normal activities at the end of the experiment. A few exposed for 1–2 hours to a temperature of −15°C. with normal atmospheric pressure were all permanently paralysed Individuals of *M. domestica* infected with *Herpetomonas muscae-domesticae* and of *T. gerstaeckeri* infected with *Trypanosoma cruzi* all died when exposed for two hours to temperatures of −15°C. and −44°C. [−47·2°F.], respectively (both with corresponding reduced pressure), but the flagellates remained alive and active within the dead insects.

Schoof (H. F.), Mail (G. A.) & Savage (E. P.). **Fly Production Sources in Urban Communities.**—*J. econ. Ent.* **47** no. 2 pp. 245–253, 7 figs., 4 refs. Menasha, Wis., 1954.

Searches for media in which flies were breeding were carried out at Charleston, West Virginia, and Phoenix, Arizona, in 1951 and 1952 and at Topeka, Kansas, in 1950. This paper is concerned mainly with the results obtained at Charleston. During both years, garbage represented about half of the positive samples detected, and produced 22 species of flies. The other half consisted of excrement and miscellaneous media (including meat, dead animals, coffee grounds and grass clippings) in roughly equal proportions. Though many of the other media yielded higher percentages of positive samples, garbage had much the greatest overall importance because of its general occurrence. The data for the other two towns agreed well with those for Charleston, except that excrement was somewhat more important in relation to the miscellaneous group because of the presence of larger animals. *Musca domestica* L. was recovered from 11 of the 13 types of media examined. In all three towns, it infested scattered garbage much more often than garbage in containers. The reverse was true of *Lucilia*

(*Phaenicia*) *sericata* (Mg.) and *L. cuprina cuprina* (Wied.) (*P. pallescens* (Shann.)). *Sarcophaga* spp. predominated in dog faeces, the kind of excrement most commonly found, and also in human faeces, in which *M. domestica*, *Ophyra* spp. and *L. sericata* were also detected. *M. domestica* was predominant among many species in fowl excrement.

The survey showed that *M. domestica* bred relatively rarely in grass clippings, meat and dead animals and that samples positive for this species were seldom found before June, so that insecticides to which it has become resistant could be used early in the season or in these specialised media without prejudicing control.

Grayson (J. McD.). **Differences between a resistant and a non-resistant Strain of the German Cockroach.**—*J. econ. Ent.* **47** no. 2 pp. 253–256, 3 graphs. 6 refs. Menasha, Wis., 1954.

After it had been reported that the German cockroach [*Blattella germanica* (L.)] was surviving treatments with chlordane in Corpus Christi, Texas [*cf. R.A.E.*, B **41** 179], the author obtained some examples collected there and reared a strain from them. Cockroaches of the third and fourth generations of this strain were compared with a normal laboratory strain in respect of resistance to technical chlordane, γ BHC as lindane and TEPP (tetraethyl pyrophosphate), and also of reproductive response, size of egg cases and weights of adults. Resistance was tested by an immersion method using suspensions of chlordane and γ BHC and a solution of TEPP. Data on the comparative toxicities of the three insecticides to the two strains are given. On the basis of median lethal concentrations, males and females of the Texas strain were 111·7 and 275·7 times as resistant to chlordane, 5·7 and 3·8 times as resistant to γ BHC and 1·9 and 1·7 times as resistant to TEPP as those of the laboratory strain. Significantly fewer nymphs per female and fewer nymphs per egg case were produced in the Texas than in the laboratory strain, and the empty egg cases produced in the former strain were shorter and narrower. Males and females of the Texas strain weighed less than the corresponding sex in the laboratory strain and the differences were highly significant.

The high degree of chlordane-resistance of this strain is comparable with that shown by another strain from Corpus Christi both initially [**41** 179] and after nine generations without intervening exposure [**42** 136]. Experimentally acquired resistance to DDT in this cockroach is less persistent [**42** 137] and, in the case of males, much smaller [**41** 139]. It would seem probable that, whereas the genetic basis for DDT-resistance in it is complex [**41** 104], the basis for chlordane-resistance is comparatively simple and that the determinants are homozygous. As regards the other responses (weight, number of nymphs produced and size of egg cases) the chlordane- and DDT-resistant strains are similar [**41** 140].

DeFoliart (G. R.). **Horn Fly Control with Chlorinated Insecticides.**—*J. econ. Ent.* **47** no. 2 pp. 266–268, 4 refs. Menasha, Wis., 1954.

During the summers of 1952 and 1953, over 60 herds of cattle in Wyoming were sprayed for the control of horn-flies [*Siphona irritans* (L.)] with wettable-powder suspensions of several insecticides at various concentrations [*cf. R.A.E.*, B **39** 63]. The sprays were applied to the top-line at a pressure of 200 lb. DDT at 0·5 and 1 per cent. and CS-708 [a mixture of 1,1-bis(p-chlorophenyl)-2-nitropropane and 1,1-bis(p-chlorophenyl)-2-nitrobutane] at 0·5 per cent. applied at 2 U.S. quarts per animal were outstanding. Each usually gave about four weeks' protection, and both were

superior to dieldrin at 0·06 per cent. (the highest concentration considered safe), heptachlor at 0·125 or 0·25 per cent., ethyl-DDD (Q-137 [1,1-bis(p-ethylphenyl)-2,2-dichloroethane]) at 1 per cent. or toxaphene at 0·5 or 1 per cent. Methoxy-DDT (methoxychlor) at 0·5 per cent. gave control for 20, 21 and 49 days in three tests, but the 49 days' protection was obtained where fly populations were unusually low. The protection period was not appreciably prolonged by increasing the concentration of DDT from 0·5 per cent. to 1 per cent., by adding 0·03 per cent. γ BHC to 0·5 per cent. DDT or by adding fused bentonite sulphur at 1 lb. per 100 U.S. gals. water to DDT or at 1 or 3 lb. to toxaphene. Applying 0·7 U.S. quart 3 per cent. DDT per animal to the shoulder area only did not produce longer protection than treating a larger area with a weaker spray. There was no evidence of the development of resistance to insecticides in *S. irritans* on herds that had received treatment in seven of the past eight years.

Hornstein (I.), Sullivan (W. N.), Tsao (Ching-hsi) & Yeomans (A. H.). **The Persistence of Lindane-Chlorinated Terphenyl Residues on outdoor Foliage.**—*J. econ. Ent.* **47** no. 2 pp. 332–335, 5 refs. Menasha, Wis., 1954.

In view of the effectiveness of chlorinated terphenyl (Aroclor 5460) in improving the persistence of lindane [γ BHC] in deposits [*cf. R.A.E.*, B **42** 131, etc.], investigations were carried out to develop sprays suitable for application to plants. The preparation of such sprays is discussed, and details are given of 16 formulations comprising lindane with the chlorinated terphenyl in suspensions and with and without it in solutions and emulsions of solutions, and of tests in which they were sprayed in various ways on the foliage of plants, including conifers, broad-leaved trees and grass, and house-flies (*Musca domestica* L.) were exposed at intervals to the residues. Some of the deposits were also tested for resistance to washing with water. It is concluded from the results that combinations of lindane and the chlorinated terphenyl are more persistent on foliage than lindane alone. They should not, however, be applied in oil solutions, which tend to penetrate the leaf surface [*cf.* **36** 19; **38** 23], or in stable emulsions, which are easily removed by washing. Effective applications of emulsions containing low-boiling ketones as the oil phase can be made if the water phase contains a fairly high concentration of a water-soluble material, such as a high-conversion maize syrup, and if either the emulsifying agent readily decomposes after application or an unstable emulsion is used.

Gahan (J. B.), Wilson (H. G.) & McDuffie (W. C.). **Organic Phosphorus Compounds as Toxicants in House Fly Baits.**—*J. econ. Ent.* **47** no. 2 pp. 335–340, 2 refs. Menasha, Wis., 1954.

The following is mainly based on the authors' summary. Good results have been achieved with baits containing TEPP or sodium arsenate for the control of *Musca domestica* L. in dairy barns [*R.A.E.*, B **42** 3, 132], but both are too dangerous to be suitable for general use. An account is given of laboratory and field tests carried out in Florida to evaluate malathion, Diazinon (O,O-diethyl O-2-isopropyl-4-methyl-pyrimidinyl(6) thiophosphate) and Bayer L 13/59 (stated to be a dialkyl phosphonate) as possible substitutes. However, since all inhibit cholinesterase, they should be used with caution. Malathion and Diazinon are available as wettable powders or emulsifiable concentrates. Technical L 13/59 is readily soluble in water.

In laboratory studies against DDT-resistant flies, Diazinon and L 13/59 were much more toxic than malathion in an aqueous solution of 10 per cent. molasses. They were highly effective at concentrations as low as 0·008 per cent. L 13/59 reduced the attractiveness of baits slightly, and certain concentrations of malathion did so markedly. Liquid baits containing these two toxicants remained highly toxic after standing for 14 days and 28 days, respectively, the longest periods tested. Diazinon was not included in either of these tests.

Practical experiments were carried out in unscreened dairies by sprinkling the baits in strips on the floors and other surfaces where flies congregated. Single applications of baits containing 0·1 per cent. malathion, Diazinon or L 13/59 and 10 per cent. attractant in water caused excellent immediate reductions of fly populations, but frequent retreatment was necessary to maintain a high level of control. Results indicated that daily treatments for about two weeks will reduce the breeding potential in most places to a point at which 2–4 treatments per week will maintain satisfactory control. Concentrations of only 0·01 and 0·02 per cent. L 13/59 were less effective initially than 0·1 per cent., but repeated treatment gave effective control in 1–3 weeks. Baits containing 10 per cent. molasses or sugar appeared to be superior to those with only 3 per cent. of these attractants or 3 or 10 per cent. maize syrup. Standard baits of 0·05 or 0·1 per cent. TEPP in 10 per cent. molasses solution did not provide such good control as most of the baits containing malathion, Diazinon or L 13/59.

Daily use of a bait containing 0·1 per cent. malathion and 10 per cent. molasses provided highly effective control of flies in a garbage-disposal area where sprays of various insecticides had proved ineffective.

Roth (A. R.). **The Toxicity of various Insecticides to *Chrysops discalis*.**—*J. econ. Ent.* **47** no. 2 p. 361, 3 refs. Menasha, Wis., 1954.

In 1953, several insecticides were tested by topical application in acetone solution on *Chrysops discalis* Will. in the neighbourhood of Summer Lake, Oregon, where this Tabanid is a serious pest. All test insects were females used on the day of capture. The most effective insecticide tested was γ BHC as lindane, which gave complete kill at 0·05 mmg. per fly. The median lethal doses ranged from 0·004 mmg. for lindane to 0·18 mmg. for toxaphene, and the order of toxicity on this basis was lindane, endrin, dieldrin, DDT, methoxy-DDT (methoxychlor), aldrin, heptachlor, EPN [ethyl p-nitrophenyl thionobenzenephosphonate], isodrin, chlordane, O,O-diethyl O-3-chloro-4-nitrophenyl thiophosphate (Bayer 22/190), Diazinon [O,O-diethyl O-2-isopropyl-4-methyl-pyrimidinyl(6) thiophosphate], 3-chloro-4-methylumbelliferone O,O-diethyl thiophosphate (Bayer 21/199), ethyl-DDD (Q-137), malathion and toxaphene.

Born (D. E.). **Mold Control in Fly Rearing Media.**—*J. econ. Ent.* **47** no. 2 p. 367. Menasha, Wis., 1954.

The growth of mould on media used for rearing house-flies [*Musca domestica* L.] has been prevented by adding a one-inch layer of sand on top of the medium, 48 hours after the introduction of the eggs. This enables the larvae to occupy the whole of the medium up to the sand. It is thought to be their activity near the top of the medium that prevents mould formation. Most of the larvae pupate in the sand, and this facilitates collection of pupae. Addition of the sand less than 48 hours after the introduction of the eggs inhibits hatching. The method has also been used

for stable flies [*Stomoxys calcitrans* (L.)], but in this case, the sand must be moistened one day before pupation is expected to ensure pupation in the sand layer.

Bechtel (R. C.) & Grigarick (A. A.). **A Method for the Evaluation and Retreatment of Insecticide-treated Cotton Strings used for House Fly Control.**—*J. econ. Ent.* **47** no. 2 pp. 369–370. Menasha, Wis., 1954.

Pieces of cotton string 3 ft. long were soaked in 10 per cent. sugar solutions containing 5 or 50 per cent. malathion or 5 or 25 per cent. Diazinon [O,O-diethyl O-2-isopropyl-4-methyl-pyrimidinyl(6) thiophosphate] or in water containing 5 or 25 per cent. Diazinon. They were then hung at intervals of two feet from beams in an animal barn in California with the lower end of each so tied that it was 3 ins. above a tray 9·5 ins. in diameter. Dead flies [*Musca domestica* L.] were collected from the trays for 36 days at three-day intervals. There was no observed decline in the killing power of any of the strings during the 36 days. The lower concentration of insecticide always gave the higher kill, old (fly-specked) strings gave higher kills than new, and strings that were not treated for the test but had been re-treated with malathion and used for three weeks before it began gave the highest of all. Omitting the sugar did not appreciably reduce kill. The average total number of dead flies per tray for each treatment varied from 596 to 1,643 for malathion and from 774 to 1,434 for Diazinon. Numbers dead per control tray were 88 for strings treated with sugar solution and 37 for untreated strings.

To re-treat strings stiff from the sugar solution used in the previous treatment, they were inserted into a 3-ft. glass tube of solution enclosed in a protective aluminium pipe and then withdrawn slowly to allow drainage.

Speroni (G.). **Impiego di sinergici nella lotta contro la mosca domestica resistente agli insetticidi di contatto.** [The Use of Synergists in the Control of *Musca domestica* resistant to Contact Insecticides.]—*Chim. e Industr.* **34** no. 7 pp. 391–403, 8 figs., 59 refs. Milan, 1952.

The author discusses the development of resistance to DDT and other insecticides in house-flies [*Musca domestica* L.] in Italy and elsewhere and concludes from a comparison of results obtained in various laboratories that resistance to insecticides of the DDT group is distinct from that to insecticides of the chlordane group, with which BHC and toxaphene can be associated. The evidence suggests that strains that have developed resistance to one of these groups normally show only weak resistance to the other, though strains resistant to both can be reared by double selection. It also appears that resistance to DDT results from enzymatic metabolism of the compound to the non-toxic DDE (1,1-bis(p-chlorophenyl)-2,2-dichloroethylene) [*cf. R.A.E.*, B **42** 6, 41, 133, etc.] and consequently that the toxicity of DDT is not due to a metabolite or to the liberation of hydrogen chloride. Resistance to DDT analogues probably results from the same cause, but the mechanism of chlordane-resistance is unknown.

Experiments are recorded in which 115 compounds were tested as synergists with DDT, and many of them with methoxy-DDT also against flies resistant to these insecticides. One of the best was DMC (bis(p-chlorophenyl)-methyl-carbinol), which was highly effective with both insecticides, but several analogues of it were ineffective, including even the ethyl homologue. The reason for this was found to lie in the synergistic action shown by the ethylene derivative of DMC [1,1-bis(p-chlorophenyl)

ethylene], which is probably formed competitively in the presence of DDT and inhibits metabolism of the latter [*cf.* next abstract]. Diphenyl-methyl-carbinol was ineffective, thus demonstrating the importance of the two chlorine atoms, and analogues in which one or both of these were in positions other than the para position were also ineffective.

Diphenylamine was effective with methoxy-DDT but rather less effective with DDT, whereas di(p-chlorophenyl)amine was effective with both, but compounds of this group were not further investigated because of the low persistence of their action and doubts as to their toxicity to warm-blooded animals. Substituted sulphoanilides were also effective or highly effective, the best being N-trichloromethyl-thiol-4-chlorobenzenesulphon-4-chloro-anilide and N-ethyl- or N-methyl-4-chlorobenzenesulphon-4-chloroanilide, which were tested with DDT only, and 4-chlorobenzenesulphon-4-chloro-anilide, which was effective with methoxy-DDT also. None of the compounds that acted as synergists for DDT showed any synergism with chlordane or γ BHC.

Perry (A. S.), Mattson (A. M.) & Buckner (A. J.). **The Mechanism of synergistic Action of DMC with DDT against resistant House Flies.**—*Biol. Bull.* **104** no. 3 pp. 426–438, 3 graphs, 24 refs. Lancaster, Pa., 1953.

An account is given of detailed investigations on the effect of DMC (bis(p-chlorophenyl)-methyl-carbinol) as a synergist for DDT against house-flies [*Musca domestica* L.] resistant to the latter [*cf. R.A.E.*, B **41** 206] and on the relationship between synergistic action and inhibition of the detoxification of DDT by its conversion to DDE (1,1-bis(p-chlorophenyl)-2,2-dichloroethylene) in the flies [*cf.* **40** 56]. The flies belonged to a multiple-resistant strain obtained from a Georgia dairy and designated Roberds. The chemicals were applied topically in benzene solution to females and mortality counts were made after 24 hours. The methods used are described.

The following is largely based on the authors' summary of the results. DMC had no insecticidal properties, but small amounts markedly enhanced the effectiveness of DDT. Thus, the mortality percentages averaged 53 and 95 for applications of 0·65 μg. DDT with 0·65 and 6·5 μg. DMC, 50 and 100 for 6·5 μg. DDT with 0·06 and 0·65 μg. DMC, 15 and 40 for 6·5 and 13 μg. DDT alone and 0 for 6·5 or 13 μg. DMC alone. The log-probit dosage-mortality lines for DDT alone and DDT with DMC showed that, under experimental laboratory conditions, the resistance of the Roberds strain could be reduced by about 98 per cent. on the basis of dosage of DDT applied. Synergistic effect was greatest when the DMC and DDT were applied together. Mortality was markedly lower when either chemical was applied 6 or 24 hours before the other.

It was found that DMC is rapidly metabolised by living flies and is excreted principally as a product tentatively identified as bis(p-chlorophenyl) acetic acid (DDA). It is suggested that 1,1-bis(p-chlorophenyl) ethylene, designated DME for convenience, is an intermediate product in DMC metabolism. In tests in which DME was applied to flies, DDA appeared in the excreta. DME showed some synergistic activity with DDT, but not so much as did DMC. A correlation was found between the extent of synergistic action and the degree of inhibition of DDT-detoxification as estimated from the amounts of DDE recovered from the flies. Mortality was complete when the percentage inhibition was 84·3. Inhibition appears to be of a competitive type, the synergist competing with the insecticide for the mechanism of detoxification [*cf.* preceding abstract].

METCALF (R. L.) & MARCH (R. B.). **Further Studies on the Mode of Action of organic Thionophosphate Insecticides.**—*Ann. ent. Soc. Amer.* **46** no. 1 pp. 63–74, 2 graphs, 13 refs. Columbus, Ohio, 1953.

Though thionophosphate insecticides such as parathion and methyl-parathion do not inhibit cholinesterases *in vitro* to any appreciable extent when highly purified to eliminate S-alkyl isomerides [*R.A.E.*, B **41** 173], it can be shown that they kill insects (and mammals) by progressive inhibition of cholinesterase of the central nervous system and they have values for median lethal dosage approximately equivalent to those of the corresponding phosphates. It is therefore evident that they are converted to anticholinesterases, presumably the oxygen analogues, by an enzyme system present in insects and mammals [*cf.* A **39** 308], and the experiments here described show that such a conversion readily occurs in the presence of mammalian and insect tissues under appropriate conditions. Most of the tests were with methyl-parathion, because it was easy to purify and handle, but parathion, isopropyl-parathion (O,O-diisopropyl O-p-nitrophenyl thionophosphate), malathion, O,O-diethyl S-carbamyl-methyl dithiophosphate and EPN (ethyl p-nitrophenyl thionobenzenephosphonate) were also used. All were highly purified to eliminate traces of the S-alkyl isomerides.

Parathion, methyl-parathion and isopropyl-parathion all produced marked inhibition of the central nervous system of *Musca domestica* L. when topically applied in doses giving about 99 per cent. mortality. The intensity of the cholinesterase inhibition was correlated with the severity of the symptoms, as previously reported for honey bees [A **38** 317]. The conversion of parathion, methyl-parathion, malathion, EPN and O,O-diethyl S-carbamyl-methyl dithiophosphate to anticholinesterase agents took place *in vitro* under aerobic conditions in the presence of slices of mouse-liver or tissue from *Periplaneta americana* (L.). In tests with methyl-parathion and cockroach gut, the reaction was prevented by heating or homogenising the tissues and by the presence of hydrogen cyanide, sodium azide, sodium selenite, iodoacetic acid, hydroxyl amine or chloropicrin; it was most rapid between pH 8 and pH 9, and, when various tissues were tested, the highest activity was found in the fore-gut, with less in the Malpighian tubules, mid-gut, nerve cord, hind-gut and fat-body and none in the muscle or cuticle.

The conversion is presumably to the oxygen analogues, as plotting percentage inhibition of fly-brain cholinesterase against solution concentration resulted in parallel curves for the methyl-parathion metabolite and methyl-paraoxon (dimethyl p-nitrophenyl phosphate), and reversed phase paper chromatography of ether extracts of breis of parathion and methyl-parathion with cockroach gut showed the formation of compounds having values equal to those of paraoxon and methyl-paraoxon, respectively.

CHERESHNEV (N. A.). **New Data on the Blackhorned Stomach Bot-fly *Gastrophilus nigricornis* Löw.** [*In Russian.*]—*Dokl. Akad. Nauk SSSR* (N.S.) **88** no. 1 pp. 169–172, 4 figs., 4 refs. Moscow, 1953.

Gasterophilus nigricornis (Lw.) was described from a single male from Bessarabia, and males have also been found in Kazan, China and Mongolia, but the female, immature stages and host were unknown [though Patton stated that the type was a female when he considered it apparently identical with *G. nasalis* (L.) (*veterinus* (Clark)) (*R.A.E.*, B **13** 162)]. Recent investigations in Kazakhstan have shown that the females fly and oviposit very rapidly, which may explain why they had not been observed before,

and that the larvae infest horses and donkeys; Sultanov described the third-instar larvae as *G. viridis*, sp. n., in 1951. The adults are present in April and May and fly in fine weather between 10 a.m. and 4 p.m. For oviposition, the female pursues horses or donkeys, which are greatly excited by it, alights on the cheek, or less frequently the nose, and attaches a single egg to a hair close to the skin. It does this repeatedly and probably deposits many eggs during its life, as dissected females contained totals of 330–350. The larvae hatch in 3–9 days and burrow under the epidermis to the corner of the mouth and then under the mucous membrane inside the cheek. They reach the central part of the cheek in about 20–30 days and then moult to the second instar, make their way to the surface of the mucous membrane and are swallowed. They pass through the stomach and embed themselves, usually in groups of 4–10, in the wall of the duodenum, which forms a swelling round them. They moult to the third instar after 60–90 days, make their way out of the swelling and attach themselves more superficially in the mucous membrane. They remain attached till March or April of the following year, when they abandon the host, drop to the ground and pupate in loose dry soil or dung. The pupal stage lasts 31–34 days.

Detailed descriptions are given of the egg, three larval instars and adult female.

Dotsenko (T. K.). **The Decipherment of the biological Cycle of the Nematode *Cheilospirura hamulosa*, a Parasite of gallinaceous Birds.** [*In Russian.*]—*Dokl. Akad. Nauk SSSR* (N.S.) **88** no. 3 pp. 583–584, 1 ref. Moscow, 1953.

Examination of large numbers of Orthoptera collected in 1950–51 on farms in the Russian Far East on which fowls were infested by the gizzard worm, *Acuaria* (*Cheilospirura*) *hamulosa*, showed that larvae of the nematode occur in the Acridid, *Oedaleus infernalis amurensis* Ikonn. It was also established experimentally that the larvae can develop in six other species of grasshoppers (Acridoidea and Tettigoniids). *Tetrix japonica* (Bol.) and *Decticus verrucivorus* (L.) were the most intensely infested and they and *O. i. amurensis* are probably the main source of infestation of the fowls. The life-cycle of the nematode can be completed in 140 days. The eggs are excreted by the fowls and hatch 5–7 hours after they are swallowed by a grasshopper. The larvae pass into the body cavity, moult twice and then (after 20 days) penetrate into the muscle and remain there. When the grasshopper is swallowed by a fowl, they make their way into the gizzard, in which they undergo two further moults and reach sexual maturity in 120 days.

Ioff (I. G.). **New Instances of Formation of Species in Fleas when changing the Host.** [*In Russian.*]—*Dokl. Akad. Nauk SSSR* (N.S.) **89** no. 1 pp. 189–192, 1 fig., 6 refs. Moscow, 1953.

The author discusses the way in which changes in the morphology of fleas can result from their adaptation to new hosts, and cites examples in which such changes have presumably occurred. Thus, gerbils (*Meriones*) in Central Asia are commonly parasitised by *Xenopsylla conformis* (Wagn.), but a form of this species, which has a larger body and eyes and relatively longer proboscis, occurs on jerboas (*Paradipus ctenodactylus* and *Dipus sagitta*) in deserts in Turkmenistan and is described as *dipodis*, subsp. n. Moreover, goats in Uzbekistan and Azerbaijan are infested by a species of

Ctenocephalides that is believed to have evolved from *C. canis* (Curt.) and is described as *C. caprae*, sp. n.

Zhivkovit' (V.). **About the Breeding Places of *Simulium colombaschensis* Fabricius outside the Danube. (Preliminary Communication.)** [*In Serbian.*]—*Arch. Sci. biol.* **4** pt. 3–4 pp. 143–145, 12 refs. Belgrade, 1952. (With a Summary in French.)

Further investigations in Yugoslavia on the distribution of the breeding places of *Simulium columbaczense* Schönb. [*cf. R.A.E.*, B **41** 112] were carried out between 3rd and 7th May 1953, and larvae and pupae were found in four rivers in the west and south of the Republic of Serbia and were abundant in certain sites in two of them. Adults were found near these sites, but the presence of numbers of pupal exuviae indicated that mass emergence had occurred at the beginning of May, some 3–5 days earlier than from the Danube. The populations of larvae and pupae in the most densely infested parts of these rivers were much smaller than they are in the Danube, which is evidently the most important source of *S. columbaczense* in Yugoslavia, though not, as had previously been believed [*cf.* **27** 85], the only one.

Barnett (H. C.) & Knoblock (E. C.). **Chemical and biologic Studies on DDT Resistance of Lice.**—*U. S. Forces med. J.* **3** no. 2 pp. 297–304, 11 refs. Washington, D.C., 1952.

Reports that DDT dusts were not producing the expected degree of control of body lice [*Pediculus humanus humanus* L.] were received from several army organisations in the Far East Command early in 1951 [*cf. R.A.E.*, B **41** 106]. Examination showed that application was thorough, and samples of DDT tested were found to be of adequate strength. Control tests were therefore made with lice collected from vagrants in Tokyo and believed to represent strains that had not been previously exposed to DDT, at least for several months. Pieces of cloth were treated with various dusts at a rate of 13 mg. per sq. in. (equivalent to 1½ oz. per uniform) and lice were confined on them for 24 or 48 hours. The controls were confined on cloth treated with talc. Twelve samples of dusts containing about 10 per cent. DDT were used; they are grouped as old American (from stocks manufactured at least five years before) and new American or Japanese (from stocks manufactured in America or Japan less than four months before the tests). In 18 tests in which the lice were exposed to old American DDT for 24 hours in petri dishes and given no opportunity to feed, mortality averaged 50 per cent. in the treated group and 23 per cent. in the controls. In 52 tests in which the lice were exposed for 48 hours in gauze-covered pill-boxes and were allowed to feed twice daily, the mortality percentages averaged 74, 75 and 47 in the groups treated with old American, new American and Japanese DDT and 46, 33 and 29 in their respective controls. The rates of mortality in all these tests were significantly lower than those that have been reported for DDT against American strains of *P. h. humanus*, and the DDT did not interfere with the feeding of surviving lice [*cf.* **34** 127]. In comparative tests by the pill-box technique with six insecticide powders other than DDT, 5 per cent. BHC (1·5 per cent. γ isomer), 0·22 per cent. pyrethrins, and a mixture of 0·2 per cent. pyrethrins, 2 per cent. piperonyl butoxide and 0·25 per cent. Phenol S, all in talc, gave complete kill within 24 hours, and three other formulae containing pyrethrins or allethrin all gave higher mortalities than DDT.

Maillot (L.). **Étude de l'infection palustre et de l'indice maxillaire chez *Anopheles gambiae* Giles à Brazzaville de décembre 1950 à février 1951.** —*Bull. Soc. Path. exot.* **46** no. 5 pp. 839–847, 2 graphs, 11 refs. Paris, 1953.

Six groups of 100 females of *Anopheles gambiae* Giles caught at Brazzaville, French Equatorial Africa, during the rainy season were examined for gland infection with malaria parasites, and the maxillary indices of 58–82 in each group were determined. Sporozoites were found in 84 of the 600 mosquitos. The maxillary indices for 67 of these and for all the 438 mosquitos for which they were ascertained are given in a table; they averaged about 13·447 and 13·644, respectively, the ranges being 11·5–16·5 and 10·5–16·5. Among females with maxillary indices of 12, 12·5, 13, 13·5, 14, 14·5, 15 and 15·5 (which comprised the great majority), the percentages infected were 32, 10, 12, 15, 16, 13, 15 and 16. There were two kinds of breeding places in the district at the time. These were rain pools, ditches, etc., corresponding to the sites of low organic content or temporary sites that Holstein [*R.A.E.*, B **41** 115] and Campbell [**40** 41], respectively, associated with paucidentate forms and sites at the edge of a stream, corresponding to the water of high organic content or permanent breeding places that these workers associated with the mosquitos of higher maxillary index.

It is concluded that there are probably at least two races of *A. gambiae* characterised by their maxillary index and by the part they play as vectors of malaria. One is composed of individuals that are paucidentate, anthropophilous and perhaps exophilous and the other of individuals that are multidentate (with a maxillary index of 12·5 or more), probable endophilous, less definitely anthropophilous and less, though still appreciably, important as malaria vectors.

Papers noticed by Title only.

Burchfield (H. P.) & Storrs (E. E.). **Kinetics of insecticidal Action** [in bioassay tests] **based on the Photomigration of Larvae of *Aedes aegypti* (L.).**—*Contr. Boyce Thompson Inst.* **17** no. 8 pp. 439–452, 2 graphs, 10 refs. Yonkers, N.Y., 1954. [See *R.A.E.*, A **43** 36.]

Hoffmann (R.). **Zur Fortpflanzungsbiologie und zur intrauterinen Entwicklung von *Glossina palpalis*.** [Reproductive Biology and intra-uterine Development in *Glossina palpalis* (R.-D.).]—*Acta trop.* **11** no. 1 pp. 1–57, 43 figs., 18 refs. Basle, 1954. (With Summaries in English and French.)

Wanson (M.) & Berteaux (M.). **La larve de l'*Anopheles mortiauxi* Edwards** [from Belgian Congo].—*Rev. Zool. Bot. afr.* **49** fasc. 1–2 pp. 33–38, 3 figs., 5 refs. Brussels, 1954. [*Cf. R.A.E.*, B **26** 182.]

Grenier (P.). **Simulidae de France et d'Afrique du Nord** [Algeria, Tunisia and Morocco].—*Encycl. ent.* (A) **29,** 170 pp., 268 figs., 5 pp. refs. Paris, P. Lechevalier, 1953. Price *Fr.* 2,500.

Dumbleton (L. J.). **The Ticks (Ixodoidea) of the New Zealand Sub-region.** —*Bull. Cape Exped. Ser.* no. 14, 28 pp., 4 pls., 18 refs. Wellington, N.Z., Dep. sci. industr. Res., 1953.

Reynier (C.). **Tiout (Sud oranais). Étude historique, géographique et médicale.**—*Arch. Inst. Pasteur Algér.* **32** no. 2 pp. 107–141, 4 pls., 3 figs., 21 refs. Algiers, 1954.

It is stated in the medical section of this survey of conditions in the oasis of Tiout near Ain Sefra, Algeria, that malaria was formerly very prevalent but is now much less so. *Anopheles hispaniola* (Theo.) is believed to be the only local vector. The improved situation is attributed to canalisation and maintenance of a large watercourse below a series of dams to prevent the formation of pools, to the abundance in many smaller channels of *Gambusia holbrooki*, first introduced in 1935, and to the treatment of children with prophylactic drugs.

Kartman (L.). **Factors influencing Infection of the Mosquito with *Dirofilaria immitis* (Leidy, 1856).**—*Exp. Parasit.* **2** no. 1 pp. 27–78, 12 figs., 3 pp. refs. New York, N.Y., 1953.

An account is given of experiments designed to provide a quantitative estimate of the infectibility of the mosquito host with *Dirofilaria immitis* and to disclose factors affecting the development of *D. immitis* in the mosquito, with a view to understanding variation in susceptibility. The mosquitos used were *Anopheles quadrimaculatus* Say, *A. freeborni* Aitken and *Aëdes aegypti* (L.) from the United States, *A. albopictus* (Skuse) from the Philippines, hybrids from a cross between *albopictus* males and *aegypti* females, several exotic strains of *A. aegypti*, and also strains of *Culex pipiens pipiens* L. and *C. p. fatigans* Wied. (*quinquefasciatus*, auct.) from Maryland and Texas, and hybrids from reciprocal crosses between these two strains [*cf. R.A.E.*, B **40** 67, 68, 187; **41** 15]. The source of *D. immitis* was a dog originating from Florida.

The following is based on the author's summary. A quantitative evaluation of the development of *D. immitis* in *A. aegypti*, *C. p. fatigans* and *Anopheles quadrimaculatus* was established. The four types of evidence used were host reaction from day to day, parasite reaction from day to day, host efficiency (the ratio between the theoretical number of microfilariae ingested by a group of mosquitos and the total number of developing larvae found in them during a specified period) and infective potential (a similar ratio involving only infective larvae).

The inheritance of susceptibility to *D. immitis* was studied in taxonomically related mosquitos. Infection of the strains of *Aëdes aegypti* and *A. albopictus* used showed that host efficiency and infective potential were 20 and 50 times as great in *A. albopictus* as in *A. aegypti*. Infection of F_1 and F_2 *albopictus-aegypti* hybrids showed no segregation of susceptibility in either generation and indicated complete dominance of the characteristics of the female (*aegypti*) parent. Infection of *C. p. pipiens* and *C. p. fatigans* showed that both host efficiency and infective potential were 2·5 times as great in the latter. F_2 reciprocal hybrids showed some segregation of physiological characters, in that host efficiencies and infective potentials were close to those of the *fatigans* parent, whereas the growth of the larvae resembled that seen in *pipiens*. Infection of *Anopheles quadrimaculatus* and *A. freeborni* indicated almost identical physiological reactions to *D. immitis* and comparable development of the parasite. Strains of *Aëdes aegypti* from the United States, South Africa and the Anglo-Egyptian Sudan gave similar host and parasite reactions, whereas a Hawaiian strain was more susceptible and a Fijian strain more refractory to the filaria.

Selective breeding of mosquitos for differential susceptibility to *D.*

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immitis was also carried out. With *A. aegypti*, it resulted in the establishment of susceptible and refractory strains. With a *Culex* hybrid produced by crossing *fatigans* females with *pipiens* males, it failed to establish either susceptible or refractory strains; the percentage infection of the selected strains was below that of both the parents and controls. The ability of the microfilariae to survive passage through the midgut was studied. All the microfilariae seen in midguts of *C. p. fatigans*, *C. p. pipiens* and their reciprocal hybrids after 48 hours were dead and disintegrating, and nearly all were dead after 24 hours, whereas some remained alive in the midguts of *A. aegypti* and *A. albopictus* for over 72 hours and in *Anopheles quadrimaculatus* and *A. freeborni* for at least 48 hours. The active migration of the microfilariae from the midgut to the Malpighian tubules was found to be mechanically inhibited by the rapid formation of blood clots in the midgut of the species of *Aëdes*, but no such barrier to migration was noted in the species of *Anopheles*. The average percentages of the parasites that were in the tubules after 24 hours were about 91 in the Anophelines and only 45 in *Aëdes aegypti* and *A. albopictus*. The addition of an anticoagulant to *in vitro* suspensions of microfilariae on which females of *Aëdes* fed caused the rate of parasite migration to the tubules to be nearly as great as that seen in *Anopheles*.

Differences between the numbers of microfilariae ingested by individual females of *Aëdes aegypti* were wide when they were fed on the infected dog and significantly less where they were fed on *in vitro* suspensions of the microfilariae. Variations in the number of ingested microfilariae were shown to be affected by the periodicity of the microfilariae in the dog, and it appeared that the mosquitos ingested a maximum mean number between 6 p.m. and 10 p.m. and a minimum between 6 a.m. and 10 a.m.

Foleyella brachyoptera [*cf.* **28** 44] was used in a supplementary experiment to test the reaction of a mosquito to infection with two species of filariae. Females of *A. aegypti* were fed simultaneously on microfilariae of *F. brachyoptera* and *D. immitis* in suspension or first on *F. brachyoptera* in suspension and several days later on the dog harbouring *D. immitis*. Each species of filaria reached its particular site of development in the mosquito, with no evidence of mutual antagonism, and its subsequent development was typical for the species.

Wolfinsohn (M.) & Galun (R.). **A Method for determining the Flight Range of *Aedes aegypti* (Linn.).**—*Bull. Res. Coun. Israel* **2** no. 4 pp. 433–436, 2 figs., 4 refs. Jerusalem, 1953.

Two experiments were carried out in desert country in southern Israel in August and September 1952 to test a new method of studying the flight-range and dispersal of *Aëdes aegypti* (L.). This consists in liberating a large number of laboratory-bred gravid females towards evening in an area free of wild *A. aegypti* and of dwellings or other objects likely to exercise attraction, and then searching for their eggs in jars that have been evenly distributed at distances of up to 2·5 km. from the point of liberation. The jars were lined with absorbent paper and not quite filled with water, and were placed in wooden boxes. The females had received their first blood-meal three days before, and all the eggs found had been laid within 24 hours of liberation. In the August experiment, 45,000 females were liberated, 86 jars were exposed, and 5,393 eggs were found in 20 jars. About 39 per cent. of the eggs were more than 0·5 km. from the liberation point and about 10 per cent. were 2–2·5 km. from it. There was no wind at the time. In the September experiment, when a westerly wind prevailed.

28,000 females were liberated, 159 jars were exposed, and 3,971 eggs were laid in 23 jars. The eggs were laid up to 2·5 km. from the point of liberation; all were to the east of it, and 80 per cent. were in a direction that did not deviate by more than 45° from the direction of the wind. Laboratory observations indicated that females lay an average of 50 eggs in 24 hours. On this basis, the percentages ovipositing in the jars (0·24 and 0·28) are deemed to have compared favourably with the average percentage recaptured by other workers using marked mosquitos [*cf. R.A.E.*, B **18** 167].

LORD (K. A.) & POTTER (C.). **Differences in Esterases from Insect Species: Toxicity of organo-phosphorus Compounds and *in vitro* anti-esterase Activity.**—*J. Sci. Fd Agric.* **5** no. 10 pp. 490–498, 23 refs. London, 1954.

Although it is generally accepted that the toxicity of organo-phosphorus compounds to mammals is related to their anti-cholinesterase activity, the evidence for a similar action in insects is not conclusive, and the authors have demonstrated inhibition of an esterase from larvae of *Tenebrio molitor* L. that did not hydrolyse acetylcholine [*R.A.E.*, A **39** 427]. In the further investigations described, the phosphorus compounds used were parathion, its isomers, O,O-diethyl S-p-nitrophenyl phosphorothiolate * and O,S-diethyl O-p-nitrophenyl phosphorothiolate *, paraoxon and tetraethyl pyrophosphate. The toxicity of these was determined for adults of *T. molitor*, *Blattella germanica* (L.) and *Dysdercus fasciatus* Sign. by topical application and for those of *Tribolium castaneum* (Hbst.) by a direct spray technique, and the inhibiting power of the compounds was tested on two esterase preparations from each species, one capable of hydrolysing phenyl acetate but not acetylcholine and the other able to hydrolyse acetylcholine. All the techniques involved are described, and the results are shown in tables.

Parathion caused no inhibition at the concentrations tested, although it was toxic to all four species. The other compounds inhibited all the esterases at great dilutions, the concentrations required for inhibiting those hydrolysing phenyl acetate only being in general lower than those for inhibition of the others, though the esterases from *T. castaneum* were about

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* These esters are named in accordance with the rules for the nomenclature of compounds containing one phosphorus atom that have been agreed by Committees of the American and British Chemical Societies and published in the journal of the British Society as an appendix in its Editorial Report on Nomenclature, 1952. Reprints of the report can be obtained from the Society, price 1*s.* (post free). According to these rules, the acids having the structures $(HO)_3PS$ and $(HO)_2PO{\cdot}SH$ are named phosphorothionic acid and phosphorothiolic acid, respectively, to indicate the position of S, while the name phosphorothioic acid $[H_3PO_3S]$ is used if the position of S is unknown or does not need to be indicated. The position of substituents in esters containing S is indicated by the symbols O- and S- prefixed to the radical; these are used in conjunction with the affix "thio" if ambiguity does not result and "thiolo" or "thiono" if it does. Consequently, parathion and its isomers could all be called phosphorothioates (since the prefixes prevent ambiguity), but the use of phosphorothiolates for the isomers in the paper noticed above emphasises their difference from parathion, which is a phosphorothionate [*cf. R.A.E.*, B **41** 3]. The rules are, of course, of general application, whereas the above example is specific; further ways in which they affect the names of insecticide chemicals are exemplified by the names phosphorodithioic acid $[H_3PO_2S_2]$, phosphorodithiolic acid $[HO{\cdot}PO(SH)_2]$ and phosphorothiolothionic acid $[(HO)_2PS{\cdot}SH]$, and the use of phosphorodithioate (with the radical prefixes) for the esters unless dithiolate or thiolothionate is necessary to avoid ambiguity. Moreover, structures containing a carbon-phosphorus linkage formed by replacement of H bound to P in any parent structure by a hydrocarbon or heterocyclic group are named by prefixing to the parent name the radical name of the replacing group. Thus, $PhPO(OH)_2$ is phenylphosphonic acid, and the name of the insecticide usually known as ethyl p-nitrophenyl thionobenzenephosphonate will consequently be O-ethyl O-p-nitrophenyl phenylphosphonothioate. It is not proposed at present to adopt the new nomenclature in this *Review* unless it is used in the papers abstracted.—*Ed.*

equally susceptible to O,O-diethyl S-p-nitrophenyl phosphorothiolate and those from *T. castaneum* and *D. fasciatus* to paraoxon. The concentration of inhibitor required for inhibition of a given series of esterases varied with species, those for inhibition of the esterases hydrolysing phenyl acetate and not acetylcholine by O,O-diethyl S-p-nitrophenyl phosphorothiolate being in the ratio 500:10:1:10 for *Tribolium*, *Tenebrio*, *Blattella* and *Dysdercus*, respectively, so that these esterases themselves appear to differ with species. Such differences in esterase susceptibility might be the cause of differences in toxicity, if the latter is due to anti-esterase activity, but no relation was found between toxicity and inhibiting power against the esterases of either type. This can be explained in the case of parathion by its conversion in insects to an active esterase inhibitor [*cf.* B **43** 29], but *in vivo* toxicity must in any case be affected by the ease of reaching the site of action and distribution within the insect and would not be expected merely to be a function of the amount of poison administered. Nevertheless, specific differences in the susceptibility of esterases may play a considerable part in determining toxicity.

No strong additional evidence was obtained that the toxic action of organo-phosphorus insecticides is due to their anti-esterase activity, but if this is the case, two types of esterase were shown to be inhibited and the one that does not attack acetylcholine would appear to be that primarily affected.

Moore (B. P.). **The Assay of ' Pyrethrin ' and Allethrin Concentrates with 2:4-Dinitrophenylhydrazine.**—*J. Sci. Fd Agric.* **5** no. 10 pp. 500–504, 1 graph, 19 refs. London, 1954.

The following is the author's summary. A new technique for the assay of " pyrethrins " and allethrin, based upon the reaction with 2:4-dinitrophenylhydrazine, is described. Comparative assays on a series of standards and concentrates indicate that the new method is consistent and accurate, but that the A.O.A.C. (Association of Official Agricultural Chemists) method [*cf. R.A.E.*, B **42** 8] gives seriously high results.

Roadhouse (L. A. O.). **Laboratory Studies of DDT-resistant House Flies (Diptera) in Canada.**—*Canad. Ent.* **85** no. 9 pp. 340–346, 4 figs., 4 refs. Ottawa, 1953.

Control of *Musca domestica* L. by DDT deposits on dairy farms in various parts of Ontario and Quebec was satisfactory in 1946 and 1947, less so in 1948 and unsatisfactory in 1949. In 1949, adults and pupae of the fly were collected from dairy farms at four of these places (two in each Province) and also from an abattoir and a remote farm on neither of which DDT had ever been used, and cultures of flies from them were reared for 40 generations. Cultures from the flies collected as adults and as pupae (designated A and P cultures in this abstract) were kept distinct, as the adults in most of the collections had been exposed to DDT before they were collected, whereas some of the pupae might have been the offspring of flies that had not been exposed. One or two A cultures were obtained from each locality and P cultures from all except the remote farm. The average mortality percentages that resulted from exposure of flies of the first 20 generations to a DDT deposit that gave about 50 per cent. kill of flies of a normally susceptible laboratory stock showed that all A cultures except the one from the remote farm and all but two of the P cultures had a significant resistance. Most of

the A cultures were more resistant than the corresponding P cultures, but there was no difference in the resistance of A and P cultures from a place where manure heaps as well as the buildings had been sprayed with DDT, which had evidently eliminated the susceptible larvae. Both cultures from the abattoir were resistant, and it is concluded that resistant flies must have migrated to it.

The degree of resistance of flies of the 21st–40th generations of these strains and of others derived from adults and pupae collected in 1951 from the same localities, in all of which DDT was replaced by chlordane, γ BHC (lindane) or methoxy-DDT (methoxychlor) in 1950 and 1951, was assessed as the median lethal concentration of a drop of DDT in acetone applied topically [*cf. R.A.E.*, B **41** 122]. The average resistance of the cultures initiated in 1949 was about 20 times that of the susceptible laboratory stock; one P culture was almost as susceptible as the latter and one A culture was over 50 times as resistant. The level of resistance remained fairly constant for as many as 39 generations in some cultures, but gradually declined in others, including the P culture from sprayed manure heaps. The culture from the remote farm and the P and A cultures from the abattoir were 12, 9 and 39 times as resistant as the laboratory stock. The average resistance of the cultures initiated in 1951 was 2,000 times that of the laboratory stock (or 100 times that of the 1949 cultures despite the change of insecticides in 1950). Resistance was even higher in the first generation of these cultures but decreased during the next 5–10 generations and then remained fairly constant. Resistance was also high in cultures reared from flies collected as pupae in Manitoba, Saskatchewan, British Columbia and Alberta in 1951; it was highest in the Manitoba culture and higher in the Saskatchewan culture than in any of the others investigated. The times required for 50 per cent. knockdown with a deposit of 100 mg. DDT per sq. ft. on glass were ascertained for all the cultures initiated in 1951 by using a modification of an apparatus already noticed [**40** 129]. They ranged from 27 to 282 minutes, as compared with 22 minutes for the laboratory stock. Complete knockdown was not obtained in the first few generations, even after exposure for more than 24 hours. The variations between strains in the median lethal concentrations and knockdown times did not appear to be associated with differences in the weight of the flies [*cf.* **42** 27].

Green (A. A.) & Kane (J.). **The Control of Blowflies infesting Slaughter-Houses. III. Large-scale Experiments at a domestic-refuse Depot.** —*Ann. appl. Biol.* **41** no. 1 pp. 165–173, 1 pl., 1 fig., 15 refs. London, 1954.

The following is based on the authors' summary. In this third part of a series [*cf. R.A.E.*, B **39** 205; **42** 195], an account is given of a field experiment carried out to control blowflies (mainly *Calliphora* spp. and *Lucilia* spp.) that fell as fully developed larvae from railway wagons carrying domestic refuse from four London boroughs and infested the soil at the sidings of a refuse collecting and sorting depot. The surface of the soil was treated so that the insects were exposed to insecticide both as migrating larvae and newly emerged adults. Dusts and emulsified solutions of DDT and BHC were compared on the basis of equal costs. The effectiveness of the treatments was measured quantitatively by trapping flies emerging from the soil. The trap is described.

DDT was more effective than BHC, all dust treatments were more effective than the sprays, and small quantities applied twice weekly were more effective than a correspondingly heavy dose applied monthly. Dust containing 4 per cent. p,p'DDT or (in brackets) 0·5 per cent. γ BHC applied

twice weekly at 308·8 (26) mg. active ingredient per sq. ft. per four weeks was estimated to have killed 79·7 (56·7) per cent. of larvae and pupae and 95·7 (90·6) per cent. of emerging adults. Overall control was 99·1 (95·9) per cent. *Musca domestica* L., which formed about 6 per cent. of the total, is included in these figures. Surviving adults were severely affected by the DDT, and equally high control was maintained when it was applied in the same way as a routine measure by the local authority.

GAN (E. I.). **New Means of controlling the Larvae of the Sheep Botfly.** [*In Russian.*]—*Veterinariya* **31** no. 3 pp. 47–52, 2 figs. Moscow, 1954.

Oestrus ovis L. causes serious losses of sheep in Central Asia where it has two generations a year, great numbers of sheep showing symptoms of infestation by the larvae in February–March and July–August, and adult flies occurring in May–June and September–October. When the flies are active, the sheep become so restless for 8–10 hours daily that they cease to graze and so lose condition. Experiments on control were carried out in Uzbekistan in 1949–51; they began with attempts to find a preparation that would be effective against the first-instar larvae, as these are more accessible than older ones. Of the many substances tested, an emulsion of the ether extract of male fern [*Dryopteris filix-mas*] gave the best results. It contains 2 per cent. of the extract by weight, emulsified with an equal amount of alcoholic soap solution in water in which 0·2 per cent. anhydrous sodium carbonate has been dissolved. The extract is ground in a mortar until it is homogeneous, the soap solution is thoroughly mixed with it and the water is then gradually added.

In the laboratory, first-instar larvae taken from fresh carcasses of sheep survived for several days in fresh spring water but some became paralysed if immersed in the emulsion. Tests in which the larvae were placed on small pieces cut from the nasal cavities of sheep and were lightly sprayed showed that the emulsion mixed rapidly with the secretion of the nasal mucosa so that its action on the larvae was prolonged for several minutes, which ensured their death. It appeared that a dosage of 10–12 ml. would be sufficient to treat the nasal cavity of a sheep if it could be evenly distributed over the surface of the cavity.

The nasal cavities of 68 infested sheep were therefore sprayed at rates not exceeding 10 ml. per head. Within 40–60 minutes of the treatment, 65 of the sheep began to discharge paralysed first-instar larvae with the exudate from the nose, and some continued to do so for at least 5–6 hours. The exudation ceased 18–20 hours after the treatment and the general condition of the animals improved until it became normal. The numbers of larvae discharged by individual sheep varied from 1 to over 200, with an average of 34·6, discharge of few indicating that only a small part of the nasal cavity had been effectively treated.

In view of this and the need for treating large numbers of sheep under farm conditions, an apparatus was designed and constructed in 1951 to enable the emulsion to be applied to all the folds of the mucous membrane of the nasal cavity at a minimum dosage and in a minimum time. It consists of a pneumatic sprayer with a cylindrical reservoir that holds about 2 gals. emulsion. One of two rubber hoses, each supplied with a tap, conveys air from the upper part of the reservoir, and the other conveys the emulsion from the lower part. The two hoses pass into one end of a metal tube within which they are joined by rubber tubing to the tubes of the nozzle. The metal tube serves as a handle for the nozzle, and a spring

closure within it prevents the passage of air and liquid through the rubber tubes unless the pressure is released by a press-button. The nozzle, which is 9 cm. long and has an outer diameter of 4 mm., consists of an inner tube to carry the liquid and an outer tube to carry the air. It has a cap at the end with a minute orifice through which the spray is atomised and dispersed in the form of a cone.

The process of treatment is described in some detail. The sheep is laid on its side on a platform, the head is fixed and the nozzle is introduced into the nasal passages and moved about in such a way that the spray reaches all the cavities but does not enter the pharynx and so cause the sheep to cough. About 10 ml. spray is injected at a pressure of 1½–2 atmospheres for a sheep and about 7·5 ml. at 1–1½ atmospheres for a lamb. It was found that one sheep could be treated in 10–15 seconds and about 200 in an hour. After the apparatus had proved highly effective in preliminary tests, it was used under farm conditions to treat about 4,500 sheep between 15th July and 5th August and about 30,000 sheep and lambs in November. No adverse effect of the treatment on the sheep was observed. Exudation from the nostrils ceased within 10–15 hours and larvae were found in samples of the exudate. No animals with any symptoms of infestation were found in the course of final examinations in February, March and early April 1952, and autopsy of 130 sheep that died during the winter showed that only 19 harboured larvae, and only four harboured more than two.

Riek (R. F.). **Studies on Allergic Dermatitis (Queensland Itch) of the Horse: the Aetiology of the Disease.**—*Aust. J. agric. Res.* **5** no. 1 pp. 109–129, 1 pl., 6 figs., 59 refs. Melbourne, 1954.

A dermatitis of horses that occurs in India, the Philippine Islands and the United States has been attributed to microfilariae of *Onchocerca reticulata* [or *O. cervicalis* if this is regarded as distinct (*cf. R.A.E.*, B **41** 100)]. An allergic dermatitis probably identical with it occurs in horses in Australia, but although 225 (80 per cent.) of 282 horses examined from central, north-western and south-eastern Queensland showed adults of *Onchocerca* in the cervical ligament, there was no correlation between infestation and signs of dermatitis, which were seen in 57 (25 per cent.) of the horses infested with *Onchocerca* and in 22 (39 per cent.) of the 57 that apparently were not. Examination of a large number of horses with and without lesions of dermatitis showed also that there was no correlation between the presence of microfilariae in the skin and the presence of the lesions.

A possible connection between the allergic dermatitis and the development of hypersensitivity was suggested by the fact that only some horses were affected, by an increase in eosinophils and accompanying local tissue eosinophilia in susceptible animals and by the blood-histamine picture. Moreover, the dermatitis is prevalent during summer and has a limited geographical distribution. These facts, together with an early claim that it could be prevented by stabling the animals at night and reports that affected animals improved when sprayed with DDT, suggested a connection with biting insects. The literature on hypersensitivity to insect bites is reviewed, and it is concluded that such hypersensitivity could be specific, and that the intradermal injection of a saline extract of the specific antigen could cause a typical reaction, and thus help in the identification of the insect involved. The relation of the histamine concentration in the blood to allergic dermatitis was also investigated. The blood histamine level in non-susceptible horses was constant throughout the day and throughout the year. In susceptible ones, however, it fluctuated widely during the day in

summer, reaching a maximum at 6–9 p.m., though it remained comparatively constant in winter. This suggested the agency of an insect active on summer evenings.

Biting insects were collected by hand from horses and also in a light-trap run at night throughout the year at Yeerongpilly. *Stomoxys calcitrans* (L.), three species of mosquitos and ten species of Ceratopogonids were taken. During mid-summer, the night catch in the light-trap yielded as many as 1,500 individuals of *Culicoides robertsi* Lee & Reye, of which 70 per cent. were females, and about 50–100 individuals of other species. *C. robertsi* was rarely taken on horses between 7 a.m. and 4 p.m. and appeared most plentiful between 6 and 10 p.m. The other Ceratopogonids were present throughout the day. The known seasonal distribution of *C. robertsi* and its geographical distribution in Queensland, where it is confined to the east, is also similar to that of the disease, and it attacked horses almost exclusively on the back-line and ears, where the lesions of dermatitis most often occur. It was not observed by the author to bite other domestic animals or man, but man has been reported to be a host. Susceptible horses stabled in an insectary from 4 p.m. to 7 a.m. during the summer did not develop dermatitis, but did so as soon as they were again allowed out at night. The skin and hair of animals with conspicuous lesions resumed a normal appearance in four weeks with similar protection from night bites, but signs of the disease appeared within three days when the horses were again allowed to graze at night. The blood-histamine concentrations of susceptible animals given the protection of the insectary showed little variation and were similar to those recorded from unaffected animals during summer and winter and to those from affected animals during winter.

Intradermal injection of antigens prepared from biting insects collected from horses or at light gave consistently positive results in susceptible horses and negative results in non-susceptible ones in the case of *C. robertsi* antigen only. The pathological and blood-histamine pictures following the use of this antigen in susceptible animals were identical with those seen in naturally occurring cases of the disease and also following experimental feeding by *C. robertsi*. A thermolabile, skin-sensitising antibody capable of passive transfer was shown to be present in susceptible horses. An immune antibody was demonstrated in susceptible horses after a course of treatment with Hapamine (histamine azoprotein), by means of the precipitin test and also by the *in-vitro* neutralisation of histamine liberated in the blood of untreated, susceptible animals. The absence of immune antibodies in non-susceptible horses is regarded as evidence that their freedom from the disease is due to an inherent immunity and not to an acquired immunity or to desensitisation.

Hammer (M.). **A new Species of Oribateid Mite from Queensland.**—*Aust. J. Zool.* **1** no. 2 pp. 236–238, 1 fig., 3 refs. Melbourne, 1953.

Roberts (F. H. S.). *Zygoribatula longiporosa* **Hammer (Oribatei: Acarina), an intermediate Host of** *Moniezia benedeni* **(Moniez) (Anoplocephalidae: Cestoda) in Australia.**—*T. c.* pp. 239–241, 1 pl., 6 refs.

In the first paper, *Zygoribatula longiporosa*, sp. n., is described from material collected in pastures in Queensland in May 1952.

In the second paper, records of mites of the supercohort Oribatei as intermediate hosts of *Moniezia expansa* and *M. benedeni* are reviewed, and a brief account is given of the collection of these mites from calf pastures in south-eastern Queensland made to ascertain the local intermediate host of *M. benedeni*. The latter is the common cestode of cattle in coastal and

subcoastal Queensland, and field observations indicate that it is sometimes pathogenic. The mites were collected in two localities between October 1951 and January 1952, and considerable numbers were obtained although a severe drought prevailed at the time. Eight species were recognised. *Z. longiporosa* and *Scheloribates* sp. were much the most abundant and a large unidentified species of *Galumna* was present in most turf samples though never numerous. The other five species, which are not named, were comparatively rare. Cysticercoids were found in 45 out of 2,430 examples of *Z. longiporosa* from one locality and 60 out of 1,044 from the other, but were not found in 2,879 of *Scheloribates* sp., 785 of *Galumna* sp. or 326 of the other mites. A previously worm-free calf passed a short chain of immature segments 42 days after ingesting a number of *Z. longiporosa* from one of the infested localities. These were identified as *M. benedeni*. The distribution of *Z. longiporosa* through the pastures varied considerably. It appeared to be most numerous in turf samples taken from dry areas and covered with short grass. The infestation rate in individual samples of the mite varied from 0 to 21 per cent. and the number of cysticercoids per infected mite from one to seven. Cysticercoids of a similar type were recovered from *Z. longiporosa* collected from a sheep pasture. *Scheloribates* sp. and *Galumna* sp. were again free from infestation.

Hawking (F.) & Mellanby (H.). **Transmission of** *Plasmodium knowlesi* **through** *Anopheles stephensi*.—*Trans. R. Soc. trop. Med. Hyg.* **47** no. 5 pp. 438–439. London, 1953.

A virulent strain of *Plasmodium knowlesi* [recently isolated by Edeson & Davey in rhesus monkeys (*Macaca mulatta*) from a kra monkey (*M. irus*) trapped in Malaya] has been twice passaged through *Anopheles stephensi* List. The mosquitos were fed on two infected rhesus monkeys and, when they contained sporozoites (after 12–14 days), they were injected into fresh monkeys, both of which became infected and died. The second donor monkey had been infected with blood of the first one that died as a result of mosquito inoculation.

Walton (G. A.). *Ornithodorus moubata* **in Wart-hog and Porcupine Burrows in Tanganyika Territory.**—*Trans. R. Soc. trop. Med. Hyg.* **47** no. 5 pp. 410–411, 6 refs. London, 1953.

References in the literature to the association of *Ornithodoros moubata* (Murr.) with large burrowing animals [*R.A.E.*, B **4** 44; **22** 6; **31** 207; **41** 8] and domestic pigs [**15** 120; **19** 179] are briefly reviewed, and the finding of this tick in burrows in Tanganyika on three occasions is recorded. On 10th September 1952, 41 nymphs and adults were found in the loose loam in the burrow of a wart-hog [*Phacochoerus*] at an altitude of 500 ft. Smears taken from the stomachs of two of them reacted to pig antisera. On 21st September, the author and another worker were attacked by large numbers of the same species while examining another burrow used by a wart-hog and three porcupine burrows in the foot-hills of the Usambara Mountains at 1,000 ft. The porcupines were absent from the burrows at the time owing to drought. Several small burrows within 30 yards of the large ones, and apparently belonging to the giant forest rat (*Cricetomys*), were examined, but no ticks were seen. In August 1953, *O. moubata* was found in six large burrows and in two hollow baobab trees at Old Shinyanga, Lake Province. The burrows and trees are used by porcupines, wart-hogs, hyaena, jackal and python.

Heisch (R. B.). *Ornithodoros moubata* (**Murray**) **in a Porcupine Burrow near Kitui.**—*E. Afr. med. J.* **31** no. 10 p. 483, 5 refs. Nairobi, 1954.

Forty-eight nymphs and adults of *Ornithodoros moubata* (Murr.) were found in a burrow containing three porcupines, about 35 miles north of Kitui in Kenya [*cf.* preceding abstract]. All these ticks were inoculated into white rats, but no spirochaetes were isolated from them. Smears from the stomach contents of two reacted to porcupine antisera. Numbers of *O. moubata* from burrows from several widely separated areas in Kenya have now been tested for spirochaetes with negative results; this is disappointing as such an isolation might lead to the discovery of the animal reservoir of *Spirochaeta duttoni*.

Kettle (D. S.). **The Effect of Light on the Biting Activity of** *Chrysops silacea* **(Diptera, Tabanidae).**—*Ann. trop. Med. Parasit.* **47** no. 4 pp. 335–339, 2 figs., 3 refs. Liverpool, 1953.

The following is based on the author's summary. The daily biting-cycle of *Chrysops silacea* Aust., as observed by Crewe & O'Rourke [*R.A.E.*, B **41** 27] at a catching station in the forest at Kumba, British Cameroons, is compared with a calculated daily cycle of the light-intensity there. The comparison reveals a close correlation between the intensity of illumination and the biting activity of the Tabanid.

Crewe (W.). **The Effect of Light on the Biting Activity of** *Chrysops silacea* **in the Forest at Kumba, British Cameroons.**—*Ann. trop. Med. Parasit.* **47** no. 4 pp. 340–343, 1 graph, 3 refs. Liverpool, 1953.

The following is mainly based on the author's summary. Observations are recorded on the daily light-intensity cycle in a particular locality in the forest at Kumba. There is no close correlation between this cycle and either the calculated cycle recorded by Kettle [see preceding abstract] or the daily biting-cycle of *Chrysops silacea* Aust. previously recorded there [*R.A.E.*, B **41** 27]. It is suggested that the correlation between Kettle's light-intensity cycle and the biting-cycle may be explained by assuming that the normal habitat of *C. silacea* is above the forest canopy [*cf.* **40** 150], in which case the main factor influencing its normal biting activity might be the light-intensity above the canopy and not necessarily the light-intensity at the place of feeding.

Gillett (J. D.) & Ross (R. W.). **The Laboratory Transmission of Yellow Fever by the Mosquito** *Aëdes* (*Stegomyia*) *strelitziae* **Muspratt.**—*Ann. trop. Med. Parasit.* **47** no. 4 pp. 367–370, 9 refs. Liverpool, 1953.

Aëdes strelitziae Muspratt has been reported to be very abundant in wooded valleys and ravines in Natal, breeding prolifically in the axils of the wild banana, *Strelitzia nicolai*, and less usually in the axils of cultivated bananas in association with *A. simpsoni* (Theo.). The two species are closely related. As the virus of yellow fever has been recovered from *A. simpsoni* [*R.A.E.*, B **31** 61] and has been transmitted experimentally by it [**17** 213], the ability of *A. strelitziae*, which attacks man even more readily than does *A. simpsoni*, to transmit the virus was investigated. In the experiment in question, details of which are given, it was shown that most of a number of females that were fed on an infected rhesus monkey (*Macaca mulatta*) subsequently contained the virus, and a few that were fed on a

susceptible monkey of the same species after an interval of 14–16 days transmitted the virus to it. The recipient monkey had circulating virus for four days and later became immune.

Bertram (D. S.). **A nesting Method used for prolonged Exposure of Cotton Rats to Superinfection with their filarial Parasite,** *Litomosoides carinii* **(Travassos, 1919).**—*Ann. trop. Med. Parasit.* **47** no. 4 pp. 371–374, 1 pl., 11 refs. Liverpool, 1953.

A description is given of the design and management of an artificial rat-nest that can be kept infested with *Bdellonyssus bacoti* (Hirst), the vector of *Litomosoides carinii*, so that cotton-rats [*Sigmodon hispidus*] and the mites can be kept together virtually indefinitely with reasonable prospects of repeated infection of the cotton-rats with the filaria taking place throughout the period.

Kershaw (W. E.), Keay (R. W. J.), Nicholas (W. L.) & Zahra (A.). **Studies on the Epidemiology of Filariasis in West Africa, with special Reference to the British Cameroons and the Niger Delta. IV. The Incidence of** *Loa loa* **and** *Acanthocheilonema perstans* **in the Rain-forest, the Forest Fringe and the Mountain Grasslands of the British Cameroons, with Observations on the Species of** *Chrysops* **and** *Culicoides* **found.**—*Ann. trop. Med. Parasit.* **47** no. 4 pp. 406–425, 2 pls., 3 figs., 9 refs. Liverpool, 1953.

The following is based on the authors' summary of this paper, which belongs to a series [*R.A.E.*, B **42** 167] in the second of which it was suggested that each species of filaria parasitising man should be considered, with its insect vector and definitive host, as a parasite combination that behaves as an entity [*cf.* **42** 168]. The equilibrium attained between the parasitic combinations involving *Loa loa* and *Acanthocheilonema perstans* and their environment can be assessed by the incidence of the infections in man. The vegetative features of mangrove swamp, of rain-forest, of the transitional zone of savannah with relict forest and of the several types of mountain vegetation that occur in the British Cameroons are described, and the results are given of surveys of the incidence of infection with *L. loa* and with *A. perstans* among the different age-groups of the human population of villages in the rain-forest, in the mountain grasslands and in the two transitional zones between them (the abrupt forest fringe on the escarpment of the western side of the Cameroon range of mountains, and the gradual-transition zone of savannah with patches of relict forest on the eastern slopes).

The incidence of infection with *L. loa* is high in the rain-forest, where *Chrysops silacea* Aust. and *C. dimidiata* Wulp, both proved vectors [*R.A.E.*, B **40** 10, etc.], are present. It falls in the abrupt forest fringe, where an additional fringe species, *C. zahrai* Oldroyd, also occurs. *L. loa* is absent from the gradual-transition zone, where nothing is known of the species of *Chrysops* that may occur, and also from the grasslands, where *Chrysops* is not found. The incidence of infection with *A. perstans* is high in the rain-forest, where *Culicoides grahamii* Aust., *C. inornatipennis* C., I. & M., *C. austeni* C., I. & M. and *C. fulvithorax* (Aust.) are present. It falls at the approaches to the abrupt forest fringe, where the population of *C. austeni*, believed to be a proved vector [*cf.* **42** 103], appears to be low. Infection is still present in the gradual-transition zone, where both *C. grahamii* and *C. inornatipennis* occur, though individual infections may have

been acquired elsewhere. It is absent from the grasslands, where only *C. grahamii* has so far been found.

The reactions of the parasitic combinations of *L. loa* and of *A. perstans* are discussed, and it is suggested that the fall in the incidence of the two infections, which occurs separately and at different rates in both the transition zones, may be due either to attenuation of the normal transmission mechanism or to the replacement of that mechanism by another peculiar to the forest fringe, possibly involving a less effective vector.

Trapido (H.) & Aitken (T. H. G.). **Study of a residual Population of *Anopheles l. labranchiae* Falleroni in the Geremeas Valley, Sardinia.** —*Amer. J. trop. Med. Hyg.* **2** no. 4 pp. 658–676, 7 figs., 6 refs. Baltimore, Md., 1953.

The response to the suspension or reduction of control measures of the very small residual population of *Anopheles maculipennis labranchiae* Flni. left in Sardinia in 1950 after the end of the eradication campaign [*R.A.E.*, B **42** 111] was investigated in 1952 by studying the population trends in the Geremeas valley in the extreme south of the island from July to September. *A. m. labranchiae* was common in this valley before the eradication campaign but was not found there after it until June 1952, when larvae were discovered along a branch of the Rio Geremeas within half a mile of the sea. Breeding places in the immediate vicinity were oiled in June, but no subsequent treatment was applied in the valley. Despite this, there was no build-up of the population of *A. m. labranchiae* in the original breeding sites, only a negligible and transitory appearance of larvae in adjacent appropriate breeding places and no build-up of the adult population in houses or animal shelters. *A. hispaniola* (Theo.) was the Anopheline most intimately associated with *A. m. labranchiae* at Geremeas, and it was found to be invading the breeding places of the latter species and replacing it. The adults of *A. hispaniola*, unlike those of *A. m. labranchiae*, do not rest in houses or animal shelters and so are not subjected to the attrition produced on species that rest in structures treated with insecticide deposits. *A. hispaniola* has been taken in Sardinia from sea level to over 2,500 ft. but was not common before 1949. The factors that may have contributed to the replacement of *A. m. labranchiae* by *A. hispaniola* are discussed. It is suggested that there may have been some fundamental alteration, through insecticidal selection, in the normal behaviour of *A. m. labranchiae*, or some change in the balance between it and other Anophelines. Such a change in behaviour might mean that the mosquito was no longer an efficient vector of malaria. The study was not continued long enough for this to be determined.

Rozeboom (L. E.). **Sexual Isolation in some North American *Anopheles* Mosquitoes.**—*Amer. J. trop. Med. Hyg.* **2** no. 4 pp. 677–682, 3 refs. Baltimore, Md., 1953.

Anopheles quadrimaculatus Say, *A. freeborni* Aitken and *A. aztecus* Hffm. are morphologically very similar to one another, but enough is now known about their habits and physiology to show that they are true species [*cf. R.A.E.*, B **40** 127; **41** 145; **42** 56]. They are so closely related, however, that a biological study of them might help to elucidate the mechanisms of speciation and the adaptation of populations to their environments. The work described in this paper was designed to determine whether they are sexually isolated from one another. A high degree of heterologous mating,

even if a preference for homologous mating were shown, would suggest that selective mating would not operate as an isolating mechanism. The strains used had been maintained in the insectary for some years. When males were given the choice of pairing with females of their own or of one of the other species, and percentage fertilisation was determined by dissection of females, males of *A. quadrimaculatus* and *A. aztecus* paired much more readily with females of their own species than with those of either of the others, but males of *A. freeborni* very readily fertilised females of *A. aztecus*, though they did not pair so readily with females of *A. quadrimaculatus*. When no choice was given, the percentages of females of *A. quadrimaculatus*, *A. freeborni* and *A. aztecus* fertilised were 69·8, 13·5 and 36·3 by males of *A. quadrimaculatus*, 28, 68·8 and 69·8 by males of *A. freeborni* and 6·4, 12·4 and 59·5 by males of *A. aztecus*. These results support conclusions drawn from other studies that *A. aztecus* and *A. freeborni* are much more closely related to one another than they are to *A. quadrimaculatus* [**40** 127; **41** 145]. The mating preferences could have arisen before or after geographic separation. However, the fact that there is only a partial barrier between *A. freeborni* and *A. aztecus* and that even females of the more distantly related *A. quadrimaculatus* may be fertilised quite readily by males of *A. freeborni*, notwithstanding a long period of geographic isolation of these populations, suggests that in this case sexual isolation was not the primary dividing mechanism. This isolation would aid, however, in keeping the present-day populations distinct, should their ranges overlap.

Dow (R. P.). **Notes on Iranian Mosquitoes.**—*Amer. J. trop. Med. Hyg.* **2** no. 4 pp. 683–695, 1 map, 4 refs. Baltimore, Md., 1953.

A list, with collection data, is given of mosquitos found by the author in central and western Persia between 5th August and 27th November 1949. The known and probable important vectors of human malaria in western Persia, all of which were taken in the present study, are *Anopheles maculipennis maculipennis* Mg., *A. m. sacharovi* Favr, *A. superpictus* Grassi and *A. stephensi* List. [*cf. R.A.E.*, B **39** 55], and *A. culicifacies* Giles, which was taken in and near Bushire, where it was the only positively identified Anopheline, but was not found anywhere else. All were found resting in man-made shelters. In the dry regions of Azerbaijan and the central plateau, the lack of other day-time habitats appears to concentrate *superpictus*, as well as *maculipennis* and *sacharovi*, in the villages, but *superpictus* seems to be a partly wild species in most of the Caspian lowlands. In south-western Persia, *stephensi*, of great importance at Abadan, appears to rest commonly in ordinary buildings, but adults of *culicifacies* were taken at Bushire only in the large covered cisterns in which rain water is stored. These provide ideal resting and breeding places, where spraying with a toxic insecticide would be most inadvisable. If this difficulty is overcome, there appears to be no entomological obstacle, other than the behaviour of *superpictus* in humid areas, to the final control of malaria in western Persia.

de Rodaniche (E. C.). **Natural Infection of the Tick,** *Amblyomma cajennense*, **with** *Rickettsia rickettsii* **in Panama.**—*Amer. J. trop. Med. Hyg.* **2** no. 4 pp. 696–699, 9 refs. Baltimore, Md., 1953.

The first two of the cases of Rocky Mountain spotted fever that have been recorded in Panama [*cf. R.A.E.*, B **42** 90] occurred in the neighbourhood of Ollas Arriba in 1950 and a third was observed there in February 1951. In 1952, ticks were collected in this area with a view to determining the vector.

Larvae, nymphs and a few adults were obtained by dragging a cloth over the ground, and many adults were picked from horses. These ticks comprised 2,436 adults of *Amblyomma cajennense* (F.), 194 of *Dermacentor* (*Otocentor*) *nitens* Neum. and 24 of *A. oblongoguttatum* Koch, about 8,000 *Amblyomma* nymphs and very large numbers of unidentified larvae. Suspensions of the ticks were inoculated into guineapigs, and a strain of *Rickettsia rickettsi*, highly virulent for them, was thus isolated on 19th March from a group of 11 adults of *A. cajennense* from a horse. Guineapigs inoculated with three other lots of adults of the same species and one inoculated with unidentified larvae showed no symptoms but developed complement-fixing antibodies against antigens of Rocky Mountain spotted fever in their sera. *A. cajennense* is one of the most abundant Ixodids in Panama, has a wide host range and attacks man readily in all stages. It is therefore excellently fitted to be an efficient vector of the disease, and it is strange that clinical cases are not more frequently seen.

Micks (D. W.) & McCollum (V.). **The Infection of** *Anopheles quadrimaculatus*, **a Human Malaria Vector, with** *Plasmodium cathemerium*, **an Avian Malaria Parasite.**—*Amer. J. trop. Med. Hyg.* **2** no. 5 pp. 930–932, 16 refs. Baltimore, Md., 1953.

Though *Anopheles quadrimaculatus* Say has been infected with exotic strains of avian malaria parasites (*Plasmodium lophurae* and *P. gallinaceum*), recent experiments with *P. praecox* (*relictum*) were the first to show that it can be infected with a parasite that occurs in birds in the United States [*R.A.E.*, B **41** 89, 203]. In the ten experiments here described, 31 of 120 females of *A. quadrimaculatus* fed on canaries infected with *P. cathemerium* became infected. The number of oöcysts per stomach varied from 3 to 600, with an average of 33. Although the oöcysts matured and appeared normal in every respect, no sporozoites were found in the salivary glands, even of females kept for an incubation period as long as 21 days. Two lots of *Culex pipiens fatigans* Wied. (*C. quinquefasciatus*, auct.) fed simultaneously with two batches of *A. quadrimaculatus* showed infection rates of 75 and 93 per cent. as compared with 27 and 50 per cent. in the latter.

P. cathemerium and *P. praecox* both occur in sparrows [*Passer domesticus*] in the United States, and *A. quadrimaculatus* was much more readily infected with *P. praecox* from sparrows [**41** 203] than from canaries [**41** 89]. On the other hand, the strains of this Anopheline and *P. cathemerium* used in the authors' experiments had been maintained in the laboratory for years, and it is possible that some genetic change had occurred in one or both, since previous attempts to infect *A. quadrimaculatus* with *P. cathemerium* freshly isolated from sparrows had been unsuccessful.

Haines (T. W.). **Breeding Media of common Flies. I. In Urban Areas.**—*Amer. J. trop. Med. Hyg.* **2** no. 5 pp. 933–940, 11 refs. Baltimore, Md., 1953.

Preliminary investigations in two small towns in south-western Georgia in 1949 established that more than 30 kinds of naturally occurring media were used for breeding by the common Muscoid flies. The relative importance of these media, grouped into five main categories, in the production of various species at different seasons was studied between May 1950 and the end of April 1951. Animal pen litter, animal wastes, animal excrement, fruit and vegetable wastes and miscellaneous wastes were observed, respectively.

1,445, 1,060, 930, 278 and 478 times. The percentages of these categories of media infested with larvae and (in brackets) the average numbers of adults reared per sample from them were 33·7 (34·2), 25·7 (60·4), 37·7 (86·4), 29·8 (28·1) and 25·1 (17·6), respectively. Corresponding figures are given for the individual species or genera of flies; for *Musca domestica* L. they were 18 (36·2), 9·6 (23·2), 12·6 (13·8), 13·7 (33·4) and 8·4 (10). The samples consisted of ¼ U.S. pint material, and some of the more heavily infested ones found on each occasion were used for rearing flies.

Over 99 per cent. of the flies found in occupied houses in the towns were *M. domestica*. This species was found to breed in all classes of media throughout the year, but particularly favoured paunch manure and packing plant wastes, and bred equally readily in cow and horse dung. No other species approached it in terms of number of infestations. Occasional high individual production of other species from any one category of breeding material was offset either by its relatively infrequent occurrence or by its restriction to certain items of material. The wide adaptability of *M. domestica*, together with its enormous reproductive potential, probably accounts for its demonstrated ability to develop insecticide-resistant populations in a short time. Its preference for human association, coupled with its relation to diarrhoeal disease caused by *Shigella* [*cf. R.A.E.*, B **41** 126] in the study area, further established it as the major species to be considered there.

Mills (A. R.). **A Malaria Survey of Futuna in the New Hebrides.**—*J. trop. Med. Hyg.* **57** no. 5 pp. 99–107, 9 figs., 2 maps, 4 refs. London, 1954.

The topography, water sources, vegetation and climate of the island of Futuna (Erronan) in the New Hebrides and its people and their occupations and living conditions are described, and population and morbidity statistics are given. Futuna lies about 41 miles north-north-east of Aneityum, where malaria is transmitted by *Anopheles farauti* Lav. [*R.A.E.*, B **42** 116]. A malaria survey made on Futuna in November–December 1952 failed to reveal any evidence of the occurrence of the disease; thick blood films taken from 286 of the 294 people on the island showed no malaria parasites and also no microfilariae. There were 164 cases of active yaws. No Anophelines were found in spite of careful searching in native houses throughout the island nor were any ever seen attempting to bite the exposed human body, though other mosquitos were often troublesome. *Aëdes scutellaris scutellaris* (Wlk.), *Culex sitiens* Wied. and *Tripteroides coheni* Belkin were the only species reared from immature stages collected in various breeding places, although conditions were suitable for *Anopheles farauti*. It is shown that geographical isolation is not responsible for the absence of Anophelines, and it is assumed that some ecological or physiological factor makes Futuna an undesirable breeding area.

Thomson (R. C. Muirhead-). **Differential Biting Habits of the Vectors as a Factor in the Age Distribution of Mosquito-borne Filariasis.**—*J. trop. Med. Hyg.* **57** no. 5 pp. 107–112, 21 refs. London, 1954.

In many parts of the wide range of *Wuchereria bancrofti*, the rates of infection with microfilariae are high in adults and low in children, particularly very young ones. Numerous hypotheses, mainly concerned with the relationship between man and the parasite, have been advanced to account for this, but none of them is entirely satisfactory, and the problem is here

discussed in the light of recent observations on the uneven distribution of Anopheline bites in people of different ages. The author has found that *Anopheles albimanus* Wied. bites older children and adults much more often than infants and very young children in Jamaica, and *A. aquasalis* Curry and *A. bellator* D. & K. tend to have the same habit in Trinidad. T. C. E. Thomas found the same tendency in *A. gambiae* Giles in West Africa. *A. gambiae* is one of the chief vectors of *W. bancrofti* in West Africa [*R.A.E.*, B **35** 172], *A. aquasalis* has been found infected with it in Brazil [**34** 60] and *A. albimanus* has been infected experimentally [**36** 115]. It is not known whether other mosquitos have the same feeding habit.

The results of surveys of the incidence of microfilariae in different age groups are reviewed from the literature for areas where filariasis is mainly transmitted by one species or at least by one genus of mosquito. The tendency to low rates in young children was apparent with *W. bancrofti* in parts of Africa and the Pacific where the main or sole vectors are species of *Anopheles* or *Aëdes*, but not in southern India and the Maldive Islands, where the vector is *C. pipiens fatigans* Wied., and was not apparent with *W. malayi* in Travancore, where the chief vectors of this filaria belong to the subgenus *Mansonioides* of *Mansonia*.

Eddy (G. W.), Cole (M. M.) & Marulli (A. S.). **Louse Powder Synergists.** —*Soap & chem. Spec.* **30** no. 7 pp. 121–123, 143, 145, 9 refs. New York, N. Y., 1954.

The following is based on the authors' summary. Details are given of laboratory tests with 22 materials as synergists with 4-methylumbelliferone O,O-diethyl thiophosphate (Potasan), 3-chloro-4-methylumbelliferone O,O-diethyl thiophosphate (Bayer 21/199) and 3-chloro-4-methylumbelliferone O,O-dimethyl thiophosphate (Bayer 21/200) against *Pediculus humanus humanus* L. The mixtures were tested as solutions for impregnating cloth, and those containing Potasan and Bayer 21/200 were also tested as powders applied to small cloth patches.

Most of the synergists increased the initial insecticidal activity of the phosphorus compounds, some as much as ten times. The duration of effectiveness was also markedly increased. The most effective synergists from an over-all standpoint were 1,2-methylenedioxy-4-(2-(octylsulphinyl) propyl)benzene (Sulfoxide), which is the n-octyl sulphoxide of isosafrole, and 1,2-methylenedioxy-4-(2-(octylsulphonyl)propyl)benzene. However, there was no synergist that proved the most effective in each type of test or with each of the compounds tested. The most effective synergists with these three compounds were ineffective with parathion, malathion and EPN [ethyl p-nitrophenyl thionobenzenephosphonate]. The discovery that certain phosphorus compounds respond to the action of synergists should not only have practical value in insect control but also help in investigations of the mode of action of synergists.

Papers noticed by Title only.

Hewlett (P. S.). **A Micro-drop Applicator and its Use for the Treatment of certain small Insects with liquid Insecticide.**—*Ann. appl. Biol.* **41** no. 1 pp. 45–64, 2 pls., 3 figs., 14 refs. London, 1954. [See *R.A.E.*, A **43** 87.]

Foote (R. H.) & Pratt (H. D.). **The *Culicoides* of the eastern United States (Diptera, Heleidae). A Review.**—*Publ. Hlth Monogr.* no. 18, iv + 53 pp., 126 figs., 2½ pp. refs. Washington, D.C., 1954.

Laven (H.) & Kitzmiller (J. B.). **Kreuzungsversuche zwischen europäischen und amerikanischen Formen des *Culex-pipiens*-Komplexes.** [Crossing Experiments between European and American Forms of the *C. pipiens* Complex.]—*Z. Tropenmed. u. Parasit.* **5** pt. 3 pp. 317–323, 7 refs. Stuttgart, 1954. (With a Summary in English.)

Previous studies on the genetic composition of populations of the complex of *Culex pipiens* L. have shown that the European autogenous form (*molestus* Forsk.) is divided into several groups, some of which are completely isolated genetically while others can be cross-bred in one direction only [*R.A.E.*, B **41** 120]. Further investigations are here reported on crossing between three German strains of the complex (H, D and O) and two American strains (P and F). H, D and O were *molestus* strains from Hamburg, Dremmen and Oggelshausen, P was a *pipiens* strain from Illinois, and F was a strain of *fatigans* Wied. from California. The DV/D ratios [*cf.* **40** 187; **41** 15] of the males of F and the *molestus* strains were typical, but that of P was on average rather above the figure typical for *pipiens*, which indicated that this strain was possibly a *pipiens-fatigans* hybrid.

All possible crosses were effected, anautogenous females being allowed a blood-meal on canaries, and the hybrid progeny were reared if possible or the eggs kept for a minimum of 4–5 days. The results were considered positive when normal, viable larvae were produced and developed into normal, fertile adults, and negative when very few or no larvae hatched, even if some of the few larvae reached the adult stage. The results were positive for the reciprocal-crosses H × P, H × F and P × F and, with the female parent cited first, for the crosses H × D, H × O, D × O, D × F and O × F. They were negative for the last five crosses with the sexes reversed, and for the reciprocal crosses D × P and O × P. They were positive for inbreeding the F_1 hybrids in the crosses D × F and O × F. The results of the reciprocal crosses of P with the three *molestus* strains, and of F with D and O, and of back-crossing the F_1 hybrids with the parent strains are given in tables, which show the numbers of eggs laid, the percentages that contained embryos and the percentages that hatched. Those that were positive in one direction only could be explained by the hypothesis of cytoplasmic factors [**40** 107; **41** 120], and this hypothesis was supported by the results of back-crossing, which were similar for F_1 males and females to those obtained with males and females of the maternal strain. It is concluded that the F_1 males must have received some cytoplasmic factor from the female parent although they receive the male-determining factor from the male. The F_1 females used in these experiments were from crosses including either P or F as one of the parents but the F_1 males were all from crosses in which one parent was F.

Taylor (R. M.) & Hurlbut (H. S.). **Isolation of West Nile Virus from *Culex* Mosquitoes.**—*J. R. Egypt. med. Ass.* **36** no. 3 pp. 199–208, 10 refs. Cairo, 1953.

The virus of West Nile encephalitis [*cf. R.A.E.*, B **31** 203; **42** 165; **43** 19] was isolated in 1950 from the blood of young children in a village about 20 miles north of Cairo, and a high immunity rate was found among older people in the district. A total of 29,760 insects, including 19,239 mosquitos, subsequently collected in the same area, and 2,273 ticks from widely dispersed parts of Egypt, were divided according to genus or species into 494 pools and these were tested for the presence of the virus. It was found in seven of the 300 mosquito pools examined, all formed from catches

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made in July and August in villages where the virus of West Nile encephalitis was recovered from the blood of eight febrile children during the same period. Four of the positive pools were composed of *Culex antennatus* (Becker) and three of *Culex pipiens* L., *C. univittatus* Theo. or both. *C. antennatus* and *C. pipiens* became infected when fed on a suckling mouse that had West Nile virus circulating in its blood, and each species transmitted the virus by biting to normal suckling mice after incubation periods of a week or more. The three species of *Culex* accounted for 92 per cent. of the mosquitos taken in the area, and were especially prevalent during July and August.

Pappas (G. D.) & Ruppel (R. F.). **A Method of obtaining axenic Larvae of** *Anopheles quadrimaculatus*.—*Exp. Parasit.* **2** no. 2 pp. 147–149. 12 refs. New York, N.Y., 1953.

The following is virtually the authors' summary. A method employing penicillin (2,000 units per ml.) and dihydrostreptomycin (1 mg. per ml.) to treat the eggs has been used successfully to obtain larvae of *Anopheles quadrimaculatus* Say bacteria-free, without any toxic effects.

DeCoursey (J. D.), Webster (A. P.) & Leopold (R. S.). **Studies on the Effect of Insecticides on the Oviposition of** *Anopheles quadrimaculatus* **Say.**—*Ann. ent. Soc. Amer.* **46** no. 3 pp. 359–365, 1 fig., 1 ref. Columbus, Ohio, 1953.

Earlier work having shown that females of *Aëdes sollicitans* (Wlk.) exposed to certain insecticides lay viable eggs just before death [*R.A.E.*, B **41** 105], a study was carried out to determine whether females of *Anopheles quadrimaculatus* Say, which have very different oviposition habits, would do the same. All insecticides were applied as powders to the inside of flasks, in which the mosquitos were exposed for 60 seconds. They comprised DDT, rotenone, chlordane, toxaphene, aldrin and γ BHC, used at 5, 2–3, 2, 0·25, 0·25 and 0·2 per cent., respectively. There were two lots of controls, one untreated and one exposed to talc. The percentages of females ovipositing within 24 hours on wet filter paper ranged from 30 to 54 for those treated with the various insecticides and were 26 for the talc controls and 60 for the untreated controls. In no case was the mean number of eggs per female laid by mosquitos exposed to insecticide significantly different from that laid by control females. The percentages of females ovipositing within five hours on dry filter paper were 30 for aldrin, 35 for BHC, rotenone and DDT, 45 for toxaphene, 50 for chlordane, 35 for talc controls and 10 for untreated controls. The figures for chlordane and toxaphene differed significantly from those for the untreated control. The mean number of eggs per female that laid was significantly higher in the case of chlordane than in the case of untreated and talc controls, and significantly lower in the case of BHC than in that of the talc control. As the results with chlordane supported the concept of forced oviposition, 30 females were sprayed with 2 per cent. chlordane in oil and 30 with distilled water, and the eggs they laid (on black paper) were counted every 15 minutes for five hours after spraying and finally after 24 hours. The total numbers of eggs laid by the chlordane-treated and (in brackets) control females were 2,226 (166) and the percentages laid in the first 15 and 30 minutes were 67 (40) and 93·5 (63). Forced oviposition did not, however,

result from a purely mechanical death stress in the case of this mosquito [*cf. loc. cit.*], since 100 females with their heads severed or crushed laid no eggs when put on water for 24 hours, though 17 out of 25 controls oviposited.

In a study of viability, the mean percentage hatch varied from 24 to 88 in eggs of insecticide-treated mosquitos and was 68 in talc controls and 83 in untreated controls. The percentages of larvae that pupated were 8–58, 29 and 40, and the percentages of pupae from which adults emerged were 86–97, 97 and 94. These adults produced an apparently normal second generation.

Annecke (D. H. S.). **Use of Dieldrin in Control of Malaria.**—*E. Afr. med. J.* **31** no. 11 pp. 491–494. Nairobi, 1954.

For the control of *Anopheles gambiae* Giles, the vector of malaria in the Transvaal, the interiors of native huts are treated with γ BHC at 30 mg. per sq. ft. or DDT at 200 mg. The two experiments described were carried out, one in the Transvaal and one in Portuguese East Africa, to determine whether sprays of dieldrin as a wettable powder applied at 30 and 40 mg. dieldrin per sq. ft., respectively, would be more effective and economical. In the first area, huts were sprayed on 30th September and 1st October 1953, and groups of ten treated and about as many control huts were examined in each month from November to May. Adults of both sexes of *A. gambiae* were found in the control huts in each of the seven months, and their numbers reached a peak (200 in 11 huts) in April, but the only ones found in the treated huts were two females in March and one in May. Weather conditions were such that breeding places for *A. gambiae* were very scarce until March. Its breeding was also very limited until March in the area of the second experiment, where huts were sprayed at the beginning of December, and groups of about 20 sprayed huts and smaller numbers of control huts were examined in each month from December to May. No mosquitos were found in the sprayed huts in December–March, but three females of *A. gambiae* were found in April and two in May. Females were found in varying numbers in the control huts in each of the seven months, the average number being about 0·8 per hut. The finding that 30 or 40 mg. dieldrin per sq. ft. kept huts free of *A. gambiae* for four months indicates that this dosage is equivalent to 30 mg. γ BHC or 200 mg. DDT. The cost for DDT at 200 mg. is 50 per cent. higher than that for γ BHC or dieldrin at 30 mg.

Bagirov (G. A.). **The common Malaria Mosquito,** *Anopheles maculipennis* **Meigen, in Bird Colonies in the Astrakhan State Reserve.** [*In Russian.*] —*Dokl. Akad. Nauk SSSR* (N.S.) **89** no. 2 pp. 381–384, 9 refs. Moscow, 1953.

Details are given of the finding in the summers of 1951 and 1952 of *Anopheles maculipennis messeae* Fln. in large numbers in the nests of various birds (chiefly large colonial-nesting species) in a nature reserve in the Province of Astrakhan. Some of the females were shown to contain avian blood, but they were evidently using the nests as resting places by day as well as feeding places; they were particularly numerous in nests that had fallen from trees to the ground and in those that, owing to their structure or position, afforded most shelter from wind. Other mosquitos were abundant in the area, but were very seldom found in the nests.

Fuller (H. S.). **Studies of Human Body Lice,** *Pediculus humanus corporis.* **II. Quantitative Comparisons of the Susceptibility of Human Body Lice and Cotton Rats to experimental Infection with Epidemic Typhus Rickettsiae.**—*Amer. J. Hyg.* **58** no. 2 pp. 188–206, 21 refs. Baltimore, Md., 1953.

The following is based on the author's summary of this account of investigations undertaken in view of the possibility that *Pediculus humanus humanus* L. (*P. h. corporis* Deg.) might respond to fewer rickettsiae than cotton rats [*Sigmodon hispidus*] and so be more useful for titrations. The "standard lice" used are defined as adult females maintained at 32°C. [89·6°F.] and 60 per cent. relative humidity that have lived 24–72 hours in the adult stage when the test meal is offered and have ingested a single meal as adults 18–24 hours before administration of the test meal, which was accomplished by a membrane technique [*R.A.E.*, B **40** 16]. The experiments showed that lice respond in a definable, observable and reproducible manner to infection with measured doses of *Rickettsia prowazekii*. It was found by quantitative comparisons of the responses that 50 per cent. of standard lice are infected by the dose needed to immunise 50 per cent. of cotton rats. There is no statistically significant difference between the dosage-response curves of the two species. Although lice and cotton rats are equally sensitive indicators of viable *R. prowazekii*, the cotton rats are preferable for routine titration owing to the complicated technique involved in the use of lice.

In view of the character of the responses of lice to measured doses of *R. prowazekii*, these insects have outstanding possibilities as tools in basic studies of rickettsiae and certain other infectious agents. Some of their potential uses are discussed.

Chereshnev (N. A.). **The Penetration of the Larvae of the first Instar of Stomach Botflies into the Organism of the Host.** [*In Russian.*]—*Dokl. Akad. Nauk SSSR* (N.S.) **91** no. 1 pp. 173–176, 3 figs., 6 refs. Moscow, 1953.

Observations in Kazakhstan on the six species of *Gasterophilus* that occur there, including those already noticed on *G. pecorum* (F.) [*R.A.E.*, B **41** 183] and *G. nigricornis* (Lw.) [**43** 29], have shown differences in the way in which horses become infested by them that may be of importance in the prevention of infestation. *G. inermis* (Brauer) resembles *G. nigricornis* in site of oviposition, spontaneous hatching of the eggs and behaviour of the first-instar larvae, and *G. haemorrhoidalis* (L.) is similar in larval behaviour, but its eggs, which are attached to the hairs on the lips of the host and develop in 3–6 days, do not hatch until they are brought in contact with moisture, which occurs when the host licks its lips or drinks.

The eggs of *G. intestinalis* (Deg.) are attached to hairs on different parts of the body of the host and mature in 6–8 days, but do not hatch without a stimulus, such as rubbing or moistening [*cf.* **5** 163; **18** 116]. Some of the eggs are ingested by the horse when it scrapes its skin with its teeth, but most of them drop on hairs that are shed through rubbing or moulting and hatch in the oral cavity if they are carried into it in fodder or water. The larvae then burrow in the mucous membrane, chiefly that of the tongue, until they reach the root of the tongue or the soft palate. This process requires some 25–30 days, after which the larvae moult, abandon the tissues and are swallowed.

The eggs of *G. nasalis* (L.) (*veterinus* (Clark)) are attached to the hairs on the intermaxillary area and front part of the neck and hatch in 8–10 days

without external stimuli. Some of the larvae drop to the ground and then reach the mouth cavity with grass, in which they are retained by their long bristles; others enter the mouth after crawling on the surface of the skin. Once they are in the mouth, the larvae crawl into the space between the jaws and teeth where they moult after 25–30 days. They then crawl out and are swallowed.

The habits of the first-instar larvae have been confirmed by experiments in that it was shown that *G. nasalis* cannot penetrate unbroken skin or mucous membranes, whereas *G. intestinalis* can penetrate mucous membranes but not skin, and the other four species can penetrate either.

Shoshina (M. A.). **Contribution to the Question of the Mechanism of the Transmission of Dermal Leishmaniasis.** [*In Russian.*]—*Dokl. Akad. Nauk SSSR* (N.S.) **92** no. 2 pp. 447–448, 2 figs., 8 refs. Moscow, 1953.

The causal agent of dermal leishmaniasis [*Leishmania tropica*] has been experimentally transmitted by *Phlebotomus papatasi* (Scop.) and adopts an anterior position in this sandfly [*R.A.E.*, B **17** 148; **30** 135], and Russian workers have found that the leptomonads may be abundant in the pharynx and buccal cavity of *P. papatasi* and *P. caucasicus* Marts. Most attempts to obtain transmission by species of *Phlebotomus* have, however, been unsuccessful, and the mechanism of it is uncertain, as the flagellates have never been observed in the salivary glands and could not be expected to move against the blood-stream when the sandfly is feeding.

In 1951, the author collected females of *P. dentatus* Sinton (*minutus* var. *arpaklensis* Perfil'ev) in an enzootic focus of dermal leishmaniasis and found that several of those that were in the last stage of blood digestion [**32** 50] and were consequently ready to feed again had motile leptomonads throughout the digestive tract. Those in the hind-gut were moving in the haematin that filled it, and soon appeared outside, round the anal aperture, having, probably, been evacuated together with the haematin by the peristalsis of the alimentary tract. It has been shown by other workers that *L. tropica* reaches the infective stage in sandflies in some 3–8 days and the author has found that the gonotrophic cycle is completed in 2–3 days [*cf.* **41** 184]. Thus, a sandfly that acquired infection with its first meal might evacuate infective leptomonads with its faeces while it was feeding again, and the vertebrate host might become infected as a result of contamination of the lesion caused by scratching the bite.

Kartman (L.). **Frequency and Intensity of *Dirofilaria immitis* Infections in Mosquitoes.**—*Exp. Parasit.* **3** no. 1 pp. 25–29, 2 graphs, 7 refs. New York, N.Y., 1954.

Data are given on the intensities of experimental infection with larvae of *Dirofilaria immitis* found in females of different mosquitos fed at the same time of day on the same dog [*cf. R.A.E.*, B **43** 33]. The percentages that became infected were 100 in *Anopheles freeborni* Aitken, 99·5 in *A. quadrimaculatus* Say, 29·8 in *Culex pipiens pipiens* L., 39·9 in *C. p. fatigans* Wied. (*C. quinquefasciatus*, auct.), 38 in the F_2 hybrids of *fatigans* males and *pipiens* females, 43·2 in the F_2 generation of the reciprocal cross, 34·5 in *Aëdes aegypti* (L.), and 99·4 in *A. albopictus* (Skuse). The mosquitos with less than 50 per cent. infection rates had few individuals harbouring more than 5 or 6 developing larvae, whereas those with infection rates approaching 100 per cent. had many individuals harbouring 10–30 larvae or more.

RATTAN LAL. **Notes on the Effect of Temperature on the developmental Stages of *Anopheles subpictus* Grassi and *Anopheles stephensi* Liston.** —*Indian J. Ent.* **15** pt. 2 pp. 97–106, 27 refs. New Delhi, 1953.

An account is given of an investigation carried out at Lahore in West Punjab in 1940–42 on the effect of temperature on the immature stages of *Anopheles subpictus* Grassi and *A. stephensi* List. Their resistance to high temperatures was considerable. Thermal death-points with exposure for one hour were 51 and 42°C. [123·8 and 107·6°F.] for eggs and pupae of *A. subpictus* and 50·5 and 41·5°C. [122·9 and 106·7°F.] for those of *A. stephensi*. Lethal temperatures for larvae of both species in the various instars were intermediate between those for eggs and pupae. The maximum observed surface temperatures of small collections of water in nature were below 45°C. [113°F.] and only occasionally as high as 43°C. [109·4°F.]. Larvae were seen to be active at these high temperatures, but pupation did not take place.

All immature stages were shortest and percentage hatch and pupation greatest at 33°C. [91·4°F.] in *A. subpictus* and at 32°C. [89·6°F.] in *A. stephensi*. The average periods for development from egg to adult at the respective temperatures were 7·7 days for *A. subpictus* and 8·1 days for *A. stephensi*, and the minima less than a week. The range of favourable temperatures was 30–35°C. [86–95°F.] for *A. subpictus* and 25–34° [77–93·2°F.] for *A. stephensi*. The difference in the lower limit explains why *A. stephensi* is common in spring while *A. subpictus* is not. Both species are abundant during summer, as the upper limits of favourable temperature are quite high. The fourth-instar larvae of both species were more resistant to low temperature than any of the other stages, and the pupae were very susceptible.

Females of *A. subpictus* almost always emerged in larger numbers than males, irrespective of the season or temperature of rearing, and the same was true of *A. stephensi*, except in winter or when the eggs were exposed for different periods to temperatures of 5–10°C. [41–50°F.]. When the eggs were kept on moist mud, the percentages viable after 6, 11 and 12 days were 64, 4 and 0 in *A. subpictus* and 70, 2 and 0 in *A. stephensi*. In nature, breeding of *A. subpictus* is entirely inhibited after December [*cf. R.A.E.*, B **19** 244]. *A. stephensi* probably passes the winter in a state of retarded growth [*cf. loc. cit.*], as the range of temperature generally observed during December–February (11–18°C. [51·8–64·4°F.]) restricts larval development but cannot destroy the larval population. The larvae generally take refuge on the bottom mud, where the temperature may be higher than at the surface.

CURTIS (L. C.). **Observations on Mosquitoes at Whitehorse, Yukon Territory (Culicidae: Diptera).**—*Canad. Ent.* **85** no. 10 pp. 353–370, 11 figs., 2 refs. Ottawa, 1953.

Mosquitos of 24 species, including 17 of the genus *Aëdes*, were found in the Whitehorse area, Yukon Territory, during the summers of 1949 and 1950. Their prevalence and the habits of the more abundant ones are discussed. The predominant pest species was *A. communis* (Deg.), followed by *A. punctor* (Kby.); *A. pionips* Dyar, though present in enormous numbers, appeared to be of only minor importance as a pest of man. No Anopheline was found at Whitehorse, but a single adult of *Anopheles carlci* Vargas was collected at Fort Nelson in north-eastern British Columbia, east of the Rocky Mountains. Wherever there was water more than a few inches deep, the predacious larvae of *Mochlonyx culiciformis* (Deg.) were present

and the pest species were almost completely absent. Well-developed larvae of *M. culiciformis* were found before the first *Aëdes* larvae hatched; the latter were quickly eliminated from the unobstructed parts of the breeding pools, but survived to mature in great numbers among the sedges of the shallow margins.

Vockeroth (J. R.). *Musca autumnalis* **Deg. in North America (Diptera: Muscidae).**—*Canad. Ent.* **85** no. 11 pp. 422–423, 4 refs. Ottawa, 1953.

Specimens of flies collected in September 1952 from a church at Middleton, Nova Scotia, where they had been abundant for more than a year and were stated to emerge from the walls, were identified as *Musca autumnalis* Deg. (*corvina* F.). Adults of the same species were later collected from buildings in four other towns in Nova Scotia, and H. C. Huckett found two in a house at Riverhead, New York, in September 1953. *M. autumnalis* has possibly been present in Nova Scotia for over a century, since Walker recorded it there (as *M. corvina*) in 1849 and 1871, but later authors have assumed that Walker's specimens were really *M. domestica* L., and that the latter was the only species of its genus definitely known to occur in North America. Characters are given for distinguishing the adults of the two species in both sexes. *M. autumnalis* is not thought to be of any great economic significance. The larvae live in cow-dung, and the adults hibernate in large numbers in buildings.

Starr (D. F.) & Calsetta (D. R.). **Ryania as a Housefly Larvacide.**—*Agric. Chem.* **9** no. 11 pp. 50–53, 10 refs. Baltimore, Md., 1954.

Experiments are reported on the use of ryania and Ryanexcel 96-3, which is a combination of 95·8 per cent. ryania, 3·2 per cent. n-propyl isome and 1 per cent. wetting agent, for the control of the house-fly [*Musca domestica* L.], mainly in the larval stage. When aqueous suspensions of ryania, at concentrations of up to 10 per cent., were applied to filter paper in petri dishes and house-fly eggs were put on the wet paper, the percentage hatch was about the same as in untreated controls, but many newly hatched larvae died even if the concentration was only 0·1 per cent. Mixing 0·5 per cent. ryania with moist standard rearing medium just before the eggs were introduced resulted in 99·9 per cent. mortality of larvae as compared with about 10 per cent. in controls. As little as 0·1 per cent. so affected the larvae that 86 per cent. died in the larval or pupal stage and the remainder gave rise to very small adults. These adults could, however, lay viable eggs. When 0·5 per cent. ryania was mixed into the medium two days after the eggs were introduced, there was only 48 per cent. mortality. When ryania was applied to the surface of the medium, mortality was higher at high concentrations if it was watered in but at 1 per cent. or less it was lower. Ryanexcel was more effective than ryania at low concentrations, the respective mortality percentages in a comparative test being 90·3 and 78·9 with a concentration of 0·1 per cent. and 99·6 and 98 with one of 0·3 per cent. It retained its toxicity in the breeding medium for at least three weeks.

To determine the number of generations needed to build up resistance to Ryanexcel, a laboratory strain of flies was reared through 20 generations in medium treated with 0·1 per cent. and 30 more in medium treated with 0·2 per cent. Mortality fell from 91 per cent. in the first generation to 53 per cent. in the third, and then did not vary enough to give evidence

of a subsequent change in resistance. The concentrations required for 90 per cent. kill in the sixth and 50th generations were not significantly different, and the selected strain was estimated to be 3–4 times as resistant as the original one. This is a very low order of resistance. Adults from surviving pupae laid fewer eggs than normal flies, and fewer of the eggs were viable.

Deposits of 200–400 mg. Ryanexcel per sq. ft. seemed more effective against adults on glass than on kraft paper, probably because they did not adhere on the glass so that, in effect, the flies were dusted. Exposure for 24 hours to 400 mg. failed to give significant kill on the paper. Ryania and Ryanexcel killed adults in 24–48 hours when added to their standard milk diet at 0·1 or 0·2 per cent. Ryanexcel gave complete mortality in 48 hours at 0·2 and 0·5 per cent. Feeding for more than two hours was necessary for a good kill. Mortality among flies given a free choice between untreated milk and milk or sugar solution containing 0·5 per cent. ryania or Ryanexcel was 60–70 per cent. in 48 hours. Ryania and Ryanexcel were less effective larvicides than malathion and γ BHC as lindane, which killed 100 and 76 per cent. of the larvae at a concentration of 0·001 per cent. However, lindane is known to be much less effective against field strains than against the laboratory one, and as malathion is extensively used as a deposit insecticide, its use as a larvicide also might lead to the rapid building-up of resistance [*R.A.E.*, B **42** 55].

In conclusion, it is stated that extensive field tests would be necessary to establish the practical usefulness of ryania, but sprinkling the floor of barns with a 5 per cent. suspension each day before the barns are cleaned and treating the barnyard with either powder or suspension about every two weeks early in the season are suggested.

Haynes (H. L.), Guest (H. R.), Stansbury (H. A.), Sousa (A. A.) & Borash (A. J.). **Cyclethrin, a new Insecticide of the Pyrethrins-type.** —*Contr. Boyce Thompson Inst.* **18** no. 1 pp. 1–16, 1 graph, 8 refs. Yonkers, N.Y., 1954.

A new insecticide, cyclethrin, was synthesised by esterification of *dl-cis* and *trans* chrysanthemic acid (chrysanthemummonocarboxylic acid) with *dl*-2-(2-cyclopentenyl)-3-methyl-2-cyclopenten-4-ol-1-one. The product (3-(2-cyclopentenyl)-2-methyl-4-oxo-2-cyclopentenyl chrysanthemate) differs from allethrin only in the substitution of the cyclopentenyl group for the allyl chain [*cf. R.A.E.*, B **41** 2] and, like allethrin, is a mixture of eight possible stereoisomers [**40** 116]. Its toxicity to mammals was no greater, and in some tests much less, than that of pyrethrins. An account is given of experiments on its effectiveness against various insects, in which it was compared with pyrethrins (standard 20 per cent. concentrates in petroleum distillate) and commercial-grade allethrin of 75–88 per cent. purity. One of the disadvantages of allethrin is that synergists are not so effective with it as they are with pyrethrins.

Oil sprays prepared by diluting the concentrates in refined petroleum distillate were tested against *Musca domestica* L. in a Peet-Grady chamber by the large-group method. At the same concentration (5, 10 or 20 per cent. w/v), pyrethrins, allethrin and cyclethrin gave about the same percentage kill in 24 hours and the same knockdown in ten minutes. In preliminary tests, piperonyl butoxide, sulfoxide (1,2-methylenedioxy-4-(2-(octylsulphinyl)propyl)benzene) and n-propyl isome (di-n-propyl 6,7-methylenedioxy-3-methyl-1,2,3,4-tetrahydronaphthalene-1,2-dicarboxylate [which is the condensation product of isosafrole and n-propyl maleate]) all showed

greater synergistic action with cyclethrin than with allethrin as regards kill and to a smaller extent as regards knockdown. Sulfoxide and piperonyl butoxide were studied in greater detail with cyclethrin and pyrethrins. Four concentrations of synergist (10, 20, 30 and 40 per cent.) were tested at three concentrations of toxicant (2·5, 5 and 7·5 per cent.), and the data for knockdown and kill with 20 per cent. synergist indicated that 1·6 and 1·7 times as much cyclethrin as pyrethrins were needed for equal performance with piperonyl butoxide and sulfoxide, respectively. The relative amounts of cyclethrin needed were slightly smaller at lower concentrations of the synergists and somewhat greater at high concentrations. Quantities of allethrin and piperonyl butoxide had to be doubled to give a spray equal in effectiveness to a pyrethrins spray.

Tests of the sprays against males of *Blattella germanica* (L.) showed that the concentrations required for 50 per cent. mortality in 48 hours when no synergist was used were 9, 33 and 54 per cent. for pyrethrins, allethrin and cyclethrin, respectively. However, cyclethrin gave better knockdown and kill than allethrin when they were used with sulfoxide and better knockdown with piperonyl butoxide. Both were inferior to pyrethrins with either synergist.

Pyrethrins at 0·1, 0·2, 0·4 and 0·8 per cent. and cyclethrin and allethrin at the three higher concentrations were also tested against *M. domestica* in low-pressure liquefied-gas aerosol formulations containing 1·6 per cent. synergist (piperonyl butoxide or sulfoxide). Averages of 1·8 times the amount of cyclethrin and 3·7–5·8 times the amount of allethrin, depending on the synergist, were needed to equal pyrethrins. When 2 per cent. DDT was added, the performance of allethrin formulations equalled that of corresponding cyclethrin formulations.

Extensive experiments have been carried out in several parts of the United States to compare the effectiveness of cyclethrin and pyrethrins applied with synergists in sprays of various kinds to protect dairy cows from *Stomoxys calcitrans* (L.), *Siphona irritans* (L.), *M. domestica* and *Tabanus*. The details of these are not given in this paper, but the over-all results show that the concentration giving adequate control was 1·6–1·7 times as high for cyclethrin as for pyrethrins.

When tested in aqueous sprays against certain pests of plants and in dusts for protecting stored grain from insect attack [*R.A.E.*, A **43** 118], cyclethrin was at least equal to allethrin in the absence of synergists, and superior in the sprays and equal in the dusts when synergists were used.

Shura-Bura (B. L.). **The Contamination of Fruits by synanthropic Flies.** [*In Russian.*]—*Ent. Obozr.* **32** pp. 117–125, 3 figs., 7 refs. Moscow, 1952.

An account is given of observations carried out in vineyards, orchards and gardens in the Crimea from the end of July to the middle of September 1950 in which it was found that ripe grapes, pears and, to a less extent, apples are visited by large numbers of flies that breed in or feed on faeces, and are contaminated by them with bacteria, particularly various forms of *Escherichia coli*. These bacteria were cultured from the surface of the fruits and from the surface and stomach contents of the flies, of which those considered to be the most important were *Sarcophaga haemorrhoidalis* (Fall.), *Lucilia sericata* (Mg.), *Muscina stabulans* (Fall.), *Musca domestica vicina* Macq. and *Fannia canicularis* (L.). The flies concentrated on damaged fruits and undamaged ones close to them. Contaminated flies were also taken on fruit and vegetable stalls in a market.

Melnick (J. L.) & Penner (L. R.). **The Survival of Poliomyelitis and Coxsackie Viruses following their Ingestion by Flies.**—*J. exp. Med.* **96** no. 3 pp. 255–271, 1 fig., 11 refs. New York, N.Y., 1952.

It was shown in earlier work that blowflies (*Phormia regina* (Mg.)) that were allowed to feed on material containing the virus of human poliomyelitis might excrete the virus for 2–3 weeks afterwards [*R.A.E.*, B **38** 10], but the precise amounts of virus taken up and excreted were not determined. In the present experiments, blowflies (*P. regina* and *Lucilia* (*Phaenicia*) *sericata* (Mg.)) and house-flies (*Musca domestica* L.) were allowed to ingest measured quantities of the virus, and the amounts excreted and remaining in the flies were determined to estimate survival and multiplication, if any. As Coxsackie virus [**41** 86] has been found with poliomyelitis virus in man and flies, it was included in the tests. The methods used are described elsewhere [see next abstract]. The source of virus was naturally infectious human faeces. The number of virus units (infective doses) in given volumes of the virus preparations were estimated from their titres. The titre for the poliomyelitis virus was the dilution capable of producing poliomyelitis in monkeys by intracerebral injection of 1 ml. when tenfold serial dilutions were tested. That for the Coxsackie virus was the infecting dilution in newborn mice injected subcutaneously with 0·02 ml.

When flies ingested poliomyelitis virus preparations with titres of at least 1:100, the virus was often detected in them for 5–17 days afterwards and in their excreta for 2–20 days. The virus did not persist significantly longer in control test tubes. In six tests in which flies received virus with a titre of 1:10, it was never subsequently detected in them and only once in their excreta, on the second day. The virus did not persist so long in the house-flies as in the blowflies, possibly because of the smaller amounts they ingested. Lowering the temperature from 25°C. [77°F.] to 9°C. [48·2°F.] cyclically or permanently increased the period of recovery. Murine-adapted strains of poliomyelitis virus and Theiler's mouse encephalomyelitis virus were detected in flies or their excreta only within five days of ingestion, although similar amounts of virus were ingested. Coxsackie virus was excreted for periods ranging from 2 to at least 12 days according to the amount of virus fed. In eight of ten experiments in which flies received 3–800 units of poliomyelitis virus and were kept at 25°C., the total amounts of virus recovered from the flies and their excreta were estimated to represent 10–130 per cent. of the amounts ingested; no virus was recovered in the other two. When 0·4 unit was given, no virus was recovered. In one experiment in which flies (*P. regina*) were kept at 9 and 25°C. in 12-hour cycles, 42 times the virus given was calculated to have been recovered. The possible significance of this experiment is discussed. It is concluded that multiplication of the virus in the fly has not been definitely proved. It was necessary to give at least 200 units of Coxsackie virus for recovery to be made. In seven experiments with doses varying from 200 to 300,000,000 units, 2–10 per cent. was recovered.

Poliomyelitis virus, as present in human faeces, survived drying and storage at 25°C. for at least three days and at 4°C. [39·2°F.] for 21 days. Coxsackie virus under the same conditions was detected for 15 days at 25°C. with a marked drop in titre after the third day and for 21 days at 4°C. with little loss in titre. Poliomyelitis virus persisted in the dried excreta of flies for at least 1–2 days at 25°C. and for 3–4 days at 4°C., and Coxsackie virus persisted for one day at 25°C. and for five days at 4°C. Poliomyelitis virus could be carried through only two serial passages in adult flies (*P. regina*) by feeding. Adults of *L. sericata* reared from larvae fed on material containing poliomyelitis virus were free from the agent [*cf.* **32** 42].

Penner (L. R.) & Melnick (J. L.). **Methods for following the Fate of infectious Agents fed to single Flies.**—*J. exp. Med.* **96** no. 3 pp. 273–280, 6 figs., 13 refs. New York, N.Y., 1952.

The methods and equipment described in this paper are those by which blowflies or *Musca domestica* L. were made to ingest known amounts of virus preparation and the virus was subsequently isolated from the flies and their excreta [see preceding abstract]. They involve the mounting of the flies on paraffin blocks [*R.A.E.*, B **41** 188], and the use of a rack for holding the blocks bearing the flies and collecting excreta and of a potometer by means of which the amount of virus preparation ingested can be measured. The potometer is made from a pipette of 0·1 or 0·2 cc. capacity, graduated in thousandths, which is sealed at one end and then has a hole blown in the side at the end of the graduation to fit the labellum of the species of fly to be fed.

Schiller (E. L.). **Studies on the Helminth Fauna of Alaska. XIX. An experimental Study on Blowfly (*Phormia regina*) Transmission of Hydatid Disease.**—*Exp. Parasit.* **3** no. 2 pp. 161–166, 1 fig., 12 refs. New York, N.Y., 1954.

The study described was carried out with a species of *Echinococcus* that occurs on St. Lawrence Island, Alaska, and for which microtine rodents serve as natural intermediate hosts. Such rodents are not known to be naturally infested on the mainland of North America. The rodents used were the common field vole (*Microtus pennsylvanicus*) and the red-backed vole (*Clethrionomys rutilus dawsoni*), and the fly was *Phormia regina* (Mg.); the red-backed voles were collected on the Alaskan mainland, and the field voles and pupae of the fly were obtained from Institutes in the United States. The enclosure constructed for the tests had three compartments, one for each kind of vole and one into which were put fly pupae and, periodically after most of the flies had emerged, fox faeces infested with *Echinococcus* eggs. The voles could not leave their own compartments, but the flies could circulate freely in all three. Two field voles died and were consumed by the remaining four. Surviving voles were killed and autopsied 30 days after the introduction of the first faecal matter. The four field voles were negative, but three of the eight red-backed voles were infested with alveolar hydatid cysts. It is not known whether the eggs were carried internally or only externally by the flies, but in view of their small size (30 × 34μ), it is probable that they were carried in both ways.

The significance of flies as vectors of hydatid disease of man in northern countries is discussed. While present information indicates that the most likely means of spread is direct contamination through close association with canine animals harbouring adult cestodes, the possible importance of flies in contaminating foodstuffs with the eggs should be borne in mind in any areas where *Echinococcus* is endemic.

Heisch (R. B.) & Furlong (M.). **Control of *Ornithodoros moubata* (Murray) by Gammexane.**—*E. Afr. med. J.* **31** no. 12 pp. 561–562, 2 fldg. tables, 5 refs. Nairobi, 1954.

The effectiveness of a spray prepared from a BHC wettable powder (P.520) against *Ornithodoros moubata* (Murr.) in native huts was investigated in two villages in the Coastal Province of Kenya in 1952–54. The floors of the huts and also the walls to a height of 12–18 ins. were sprayed at the

rate of 12 oz. P.520 in 1 gal. water per 1,000 sq. ft. (about 20 mg. γ isomer per sq. ft.). At Kwale in the Shimba Hills, ticks were rapidly reduced in numbers in ten treated huts and had almost disappeared from them after five weeks, but a few appeared in one hut after 11 weeks. The huts were treated again three months after the first application and remained free of ticks for eight months; four subsequently showed reinfestation. Control huts remained heavily infested throughout. At Tiwi on the coast, ten huts were treated with the spray and ten with Gammexane insect powder containing 0·5 per cent. γ BHC [*cf. R.A.E.*, B **42** 17], which was sprinkled over floors and a little way up walls at 4 lb. per 1,000 sq. ft. The powder reduced the number of ticks but did not eliminate them, whereas the spray gave complete elimination and remained effective for three months. Both lots of huts and the ten controls, which had remained heavily infested, were then treated with the spray, together with 136 intervening dwellings. Eight months later, ticks had reappeared in only two of the 30 huts, both former controls that had been treated only once. These results demonstrate the importance of treating all huts in an infested area, and the superiority of several treatments over one.

Pratt (H. D.) & Good (N. E.). **Distribution of some common Domestic Rat Ectoparasites in the United States.**—*J. Parasit.* **40** no. 2 pp. 113–129, 12 figs., 3 pp. refs. Lancaster, Pa., 1954.

As a result of work in connection with the programme for the control of murine typhus in the United States [*cf. R.A.E.*, B **40** 30; **41** 31, 132; **42** 141, etc.], much new information has become available on the distribution of several common ectoparasites of domestic rats (*Rattus rattus* and *R. norvegicus*). The data are much more complete for the south-eastern States than for other parts, because the greatest number of typhus cases occurred there and collections of ectoparasites were consequently most numerous. In this paper, the distribution in the United States of ten common ectoparasites of rats and *Allodermanyssus sanguineus* (Hirst), which infests the house mouse (*Mus musculus*) and transmits rickettsialpox [**37** 165], is shown on maps and discussed on the basis of the observations referred to and of the literature. The rat parasites dealt with are *Xenopsylla cheopis* (Roths.), *Nosopsyllus fasciatus* (Bosc), *Leptopsylla segnis* (Schönh.), *Echidnophaga gallinacea* (Westw.), *Polyplax spinulosa* (Burm.), *Hoplopleura acanomydis* Ferris, *Bdellonyssus bacoti* (Hirst), *Laelaps echidninus* (Berl.), *L. nuttalli* Hirst and *Haemolaelaps glasgowi* (Ewing). *A. sanguineus* has been found on rats (*R. norvegicus*) in Utah.

Heisch (R. B.), Grainger (W. E.) & D'Souza (J. St.A. M.). **Results of a Plague Investigation in Kenya.**—*Trans. R. Soc. trop. Med. Hyg.* **47** no. 6 pp. 503–521, 1 map, 17 refs. London, 1953.

The Rongai area of Kenya is a plain, 6,000 ft. above sea level, bounded by the escarpments of the Rift Valley; it extends northwards to the Baringo bush country and reaches Njoro in the south. Plague in man has been known to occur there sporadically for many years, but the outbreaks were small until 1952, when there were more than 70 cases. It has never been reported from the arid semi-desert Baringo bush country, and no evidence was obtained that the rodents there (mainly *Arvicanthis abyssinicus* and *Taterillus* sp.) ever harbour *Pasteurella pestis*. Infection among wild rodents in Kenya was first demonstrated early in 1952 at Rongai. During the outbreak in that year, huts and the burrows of domestic rats (*Rattus*

rattus kijabius), which here live in the ground, not in the roofs of dwellings, were dusted with a BHC powder (3 per cent. γ isomer) or 10 per cent. DDT powder. No fleas appeared on 12 white rats that were caged in huts treated with BHC and examined daily for a month, whereas rats put in untreated dwellings collected 25 fleas, including *Xenopsylla cheopis* (Roths.) and *X. brasiliensis* (Baker).

Rodent and flea surveys were made in 1952–53. In January 1952, *A. abyssinicus* was the dominant wild rodent at Rongai, and *Rattus natalensis* (*Mastomys coucha*) was also numerous. Both were semi-domestic in their habits. Domestic rats were comparatively scarce, presumably because of mortality due to plague. Other rodents caught included *Rhabdomys pumilio* and *Otomys angoniensis*. During the dry weather in March 1953, very few domestic rats and comparatively few wild rodents were found, but the *Otomys* population had increased. *X. cheopis* and *Dinopsyllus ellobius lypusus* J. & R. were the dominant rodent fleas in the area, and *X. brasiliensis* was found only in small numbers. All three occurred on both domestic rats and wild rodents; *D. e. lypusus*, which is mainly a field species, was particularly numerous on *Rattus natalensis*. Only *Ctenocephalides crataepus* (Jordan) was collected from *Euxerus* sp., which can have virtually no contact with other rodents, and *Taterillus* sp. was chiefly infested with *X. nubica* (Roths.). Keruguya, an old plague focus in the southern foothills of Mount Kenya at an altitude of 4,200–5,200 ft. [*R.A.E.*, A **25** 157], where no plague in man had been reported since 1937, was surveyed in July–August 1952. In this area, *R. r. kijabius* lives in roofs and has little contact with wild rodents; 839 examples of this rat caught in the villages yielded 1,603 fleas of which 1,550 were *X. brasiliensis* and only eight *X. cheopis*. *X. cheopis* was scarce and *X. brasiliensis* virtually absent on wild rodents, which were not numerous and were only lightly infested by other fleas.

Attempts to isolate *P. pestis* from *X. brasiliensis*, domestic rats and a few field rodents at Keruguya were unsuccessful, but the failure is not considered conclusive. Plague was active at the time of the first survey at Rongai, and man, domestic rats and wild rodents all harboured infection. *P. pestis* was isolated ten times from *A. abyssinicus*, four times from *R. natalensis*, twice from *Rhabdomys pumilio*, twice from *O. angoniensis*, once from *X. cheopis* and once from *D. e. lypusus*. It was isolated again from *R. natalensis* and *O. angoniensis* and pools of fleas from field rodents in February and March 1953, when domestic rats gave negative results. At Konza, a village near Machakos, where there was a sharp outbreak in January 1953, a pool of spleens from six living individuals of *A. abyssinicus* and one of *R. natalensis* proved to be infected.

Susceptibility tests, in which animals were inoculated with dilute cultures, indicated that *A. abyssinicus* and *R. natalensis* from Rongai had a high resistance to plague. Some survived, and others lived for 15–38 days. *Otomys* usually died after 4–9 days, and *Taterillus* sp., the most susceptible animal tested, invariably succumbed after three days. The fact that in 1953, when enzootic conditions prevailed at Rongai, *P. pestis* was isolated from wild rodents and fleas but not from domestic rats indicates that wild rodents are the primary reservoir. The chief ones involved are *A. abyssinicus*, *R. natalensis* and *O. angoniensis*, which live in close ecological association. There is no evidence that the domestic rat is the primary reservoir in Kenya. It is thought to be always secondarily infected. *X. cheopis* is regarded as the chief transmitting agent at Rongai. *D. e. lypusus* will probably prove to be an important vector of plague among wild rodents in Kenya. Some of the fleas removed from wild rodents and thought at first to be *X. cheopis*, were later found to be *X. bantorum* Jordan, an

indigenous species of which the vector capacity is unknown. The occurrence of intermediate forms indicated that some interbreeding had occurred.

Davidson (G.) & Draper (C. C.). **Field Studies of some of the basic Factors concerned in the Transmission of Malaria.**—*Trans. R. Soc. trop. Med. Hyg.* **47** no. 6 pp. 522–535, 2 graphs, 19 refs. London, 1953.

The following is virtually the authors' summary. Observations made on the human population and the vector mosquitos in a coastal area of Tanganyika where malaria is " holo-endemic " (with a high rate of infection in early life followed by the acquisition of considerable immunity) are described. The malaria inoculation rate in infants as derived by analysis of parasite indices was about once in every 100 days, whereas the theoretical rate derived from entomological data (vector densities, feeding habits and sporozoite rates), was once in every 1–10 days. Possible reasons for this discrepancy are discussed; the chief factor is considered to be suppression by the infants of the majority of sporozoite inoculations before parasitaemia ensues. It is not thought that selective biting of different age-groups [*R.A.E.*, B **43** 48] occurs to any great extent.

Studies of the vector species, *Anopheles gambiae* Giles and *A. funestus* Giles, confirmed that in this area they are strongly anthropophilic, will feed within 24 hours of emergence, probably require two blood-meals to mature the first batch of eggs and have a 48-hour gonotrophic cycle, and that a significant proportion of half-gravid females of *A. gambiae* leave human habitations to mature their eggs elsewhere. The survival rate of the vector species was measured by a new technique involving the comparison of the immediate sporozoite rate on capture with that found after keeping wild-caught mosquitos alive for the duration of the extrinsic cycle. It is estimated that *A. gambiae* showed a natural daily mortality of the order of 7 per cent. and *A. funestus* of the order of 8 per cent. Mortalities among wild-caught mosquitos kept in cages, while generally lower than these, confirm that *A. funestus* shows a higher mortality than *A. gambiae*. Such values of naturally occurring mortalities are perfectly consistent with the sporozoite rates found. The implications of these findings in relation to control by insecticide deposits are discussed.

Huehns (E. R.). **Filariasis in Mauritius.**—*Trans. R. Soc. trop. Med. Hyg.* **47** no. 6 pp. 549–555, 1 graph, 1 map, 13 refs. London, 1953.

An account is given of a survey in which blood samples taken at night from more than 2,500 people in 17 centres of population distributed over the whole of Mauritius were examined, and 11 per cent. were found to be infected with microfilariae of *Wuchereria bancrofti*, the only filaria seen. The incidence was greater in males than females and in adults than children [*cf. R.A.E.*, B **43** 47], and it varied from place to place with mosquito activity. Examination of blood samples taken from ten soldiers throughout the 24 hours showed that periodicity is strictly nocturnal. Elephantiasis and other clinical manifestations occurred but were not frequent. *Culex pipiens fatigans* Wied., *Anopheles gambiae* Giles, *A. funestus* Giles and *A. maculipalpis* Giles have been shown to be able to transmit *W. bancrofti* in Mauritius [**25** 108; **39** 147], but *A. funestus* has been eradicated there [**43** 6]. Filariae failed to develop in 30 experimentally infected females of *A. coustani* Lav. [*cf.* **25** 108].

Nielsen (E. T.) & Nielsen (A. T.). **Field Observations on the Habits of** *Aedes taeniorhynchus*.—*Ecology* **34** no. 1 pp. 141–156, 6 figs., 11 refs. Brooklyn, N. Y., 1953.

An account is given of observations on the life-history of *Aëdes taeniorhynchus* (Wied.) in Florida [*cf. R.A.E.*, B **43** 2] from which the following conclusions are drawn. The mosquitos remain for 12–24 hours near the pool from which they have emerged and then disperse over a considerable area during the next three days. They spend most of their lives in resting places that have not yet been located. The females feed cyclically, when they are about 4, 9 and 14 days old. They perform special flights when ready to oviposit, generally when they are about 7, 12 and 17 days old. Most of them live for 3–4 weeks, though some survive much longer; old females sometimes feed, but do not lay eggs. All eggs present in an area seem to hatch at the first inundation. Adults, with the exception of females ready to oviposit, were repelled by light. Males form swarms close to the top of some prominent object soon after sunset and before sunrise throughout the 2–3 weeks of their lives from the age of four days. The individual males participate in the swarm for only a fraction of its total duration, which may vary from 12 to 27 minutes. Mating was not observed in the swarms and probably took place during the first days of adult life before the swarming period.

Kartman (L.). **On the Growth of** *Dirofilaria immitis* **in the Mosquito.**—*Amer. J. trop. Med. Hyg.* **2** no. 6 pp. 1062–1069, 3 graphs, 11 refs. Baltimore, Md., 1953.

The following is based on the author's summary of this account of studies that form part of an investigation of which certain aspects have already been noticed [*R.A.E.*, B **43** 33, 53]. Generally similar growth curves of larvae of *Dirofilaria immitis* were noted in *Culex pipiens pipiens* L., *C. p. fatigans* Wied. (*quinquefasciatus*, auct.), F_2 hybrids between these two forms, *Aëdes aegypti* (L.), *A. albopictus* (Skuse), *Anopheles quadrimaculatus* Say and *A. freeborni* Aitken. The host constitution apparently affected the size attained by the filaria larvae. The larval length/width ratio varied considerably between genera and also, in *Culex* and *Aëdes*, between species, but not so much in *Anopheles*. Thus, phylogenetic affinities between mosquito species do not necessarily imply similar growth of the dog filaria within them. Third-stage larvae undergo considerable change in length, especially in favourable hosts. Nevertheless, 20 days after the infective meal, third-stage larvae are still divided into long and short individuals. It is not known whether this is linked with sex differentiation.

Charles (L. J.) & Senevet (G.). **The Distribution of** *Anopheles albimanus* **in the Caribbean Islands.**—*Amer. J. trop. Med. Hyg.* **2** no. 6 pp. 1109–1115, 1 map, 22 refs. Baltimore, Md., 1953.

Rozeboom (L. E.). **A Note on the Presence of** *Anopheles albimanus* **in Barbados.**—*T. c.* p. 1116.

The following is based on the authors' summary of the first paper. The presence of *Anopheles albimanus* Wied. in the island units of the Caribbean is discussed. Field observations have now established its absence from Trinidad, Grenada, St. Vincent, Barbados, St. Lucia and Dominica, from which it had been recorded in the past, and also from Tobago, Martinique, St. Kitts and the Netherlands Leeward and Windward Islands. The southernmost point of its distribution in the island chain is at latitude 15°53′N. in

Marie Galante. In the Caribbean Islands, it is limited to Guadeloupe (and Marie Galante), Montserrat, Antigua, Nevis, the Virgin Islands (St. Croix, St. Thomas and Tortola) and the Greater Antilles.

In the second paper, Rozeboom confirms the identification of specimens in the collection of the Johns Hopkins University that are labelled as *A. albimanus* received from Barbados in 1928, and probably represent some of the material on the basis of which Seagar recorded the species there [*R.A.E.*, B **16** 119]. It is not known why this species, which is hardy, died out on an island close to its natural range and on which it seemed well established. Information on this point would be of value in planning eradication measures elsewhere.

Welch (S. F.) & Schoof (H. F.). **The Reliability of "Visual Surveys" in evaluating Fly Densities for Community Control Programs.**—*Amer. J. trop. Med. Hyg.* **2** no. 6 pp. 1131–1136, 3 refs. Baltimore, Md., 1953.

Scudder's grill method of estimating fly populations [*R.A.E.*, B **38** 158] has been widely adopted in campaigns for fly control in urban areas in the United States [**39** 86; **41** 126; **42** 3] and has proved very satisfactory. However, the time needed to make the surveys is a great disadvantage. Because field observations had indicated that inspectors experienced in the use of the grill could make a fairly accurate estimate of what a count would be by visual survey of the fly population at the chosen site [*cf.* **42** 3], comparison was made of the numbers of flies actually counted with a grill and "visually estimated on a grill count basis" by two men on each of 2,850 attractant sites at Phoenix, Arizona, in 1951. Eight two-man teams were used, and the results were examined statistically. Correlations between the two methods were highly significant for all teams. The visual estimate agreed with the grill count by the same inspector with an accuracy of 69–89 per cent. Agreement between the two inspectors in each team was also highly significant; it was 89–98 per cent. when actual counts were used, and 75–91 per cent. for visual estimates.

In practice, control measures are generally instituted when grill counts exceed a certain number of flies, called the threshold value, which varies with circumstances. The relationship of the visual and grill methods was further tested by applying theoretical threshold values to indicate the necessity for control measures. The inspectors were in agreement, with the exception of one team for the visual method. It is estimated that, in average circumstances, visual surveys can be completed in about a third of the time required for grill surveys.

Papers noticed by Title only.

Storrs (E. E.) & Burchfield (H. P.). **Joint Action of binary Mixtures of Insecticides** [determined by tests on larvae of *Aëdes aegypti* (L.)].—*Contr. Boyce Thompson Inst.* **18** no. 1 pp. 69–78, 5 graphs, 8 refs. Yonkers, N.Y., 1954. [See *R.A.E.*, A **43** 119.]

Doss (M. A.) & Humphrey (J. M.). **Index-catalogue of Medical and Veterinary Zoology. Supplement 2. Authors: A to C.**—pp. [1+] 318–457. Washington, D. C., U.S. Dep. Agric., 1954. Price 50 *cts.* (from Supt. Documents). [*Cf. R.A.E.*, B **42** 80.]

DAVIES (A. M.) & YOSHPE-PURER (Y.). *Aedes aegypti* **as a Vector of West Nile Virus.**—*Bull. Res. Coun. Israel* **3** no. 1–2 pp. 127–128, 1 graph, 4 refs. Jerusalem. 1953.

It appears probable that a virus, believed to be the West Nile virus, that has been isolated from patients in Israel [and Egypt] is transmitted there by mosquitos of the genus *Culex* [*R.A.E.*, B **43** 19–20, 49–50], and a strain (EV 101) of the virus [originally isolated from an Egyptian child] has been transmitted by *Aëdes aegypti* (L.) to laboratory animals [**43** 21]. Evidence is now presented that the virus can multiply in the body of *A. aegypti*. Females of this mosquito were infected with EV 101 by feeding them on a mixture of mouse-brain suspension, honey and defibrinated blood containing 10^4 median lethal doses for mice per 0·1 ml. and were then kept at 28°C. [82·4°F.] and a relative humidity of 65–70 per cent. on a diet of honey and water. Those still alive after a week were counted, killed, emulsified in 10 per cent. serum saline and mixed with honey and defibrinated blood. A second group of mosquitos was then fed on this mixture, and the process was repeated for five passages. Mosquitos of the fifth passage were emulsified and injected at a dilution of 1:10 intraperitoneally into six mice aged 14 days. Five of the mice died with characteristic signs of West Nile disease. As it is calculated that the final dilution of the original meal was 7×10^{-9}, multiplication must have occurred in the mosquitos.

In a second experiment, large batches of *A. aegypti* were infected with three different lines of West Nile virus, one in embryonated eggs [**43** 21] inoculated with a strain (P.H. 106) recently isolated in Israel and two on hamsters inoculated with an egg-adapted or a hamster-adapted line of EV 101. The titre of EV 101 in the blood at the time of feeding was determined, and the titre of all virus lines in representative groups of mosquitos was determined at successive intervals thereafter. In the two EV 101 series, there was an initial rapid fall of titre followed by a rise after 1–2 days to a level that surpassed the initial titre within a week and continued to be significantly above it. The titre rose similarly in the strain P.H. 106. Examination of groups of infected mosquitos revealed the presence of virus in the head, thorax, abdomen, wings and legs, indicating distribution in all parts of the body. This does not occur with mechanical transmission of a virus.

DAVIES (A. M.) & YOSHPE-PURER (Y.). **The Transmission of Semliki Forest Virus by** *Aedes aegypti*.—*J. trop. Med. Hyg.* **57** no. 11 pp. 273–275, 2 graphs, 6 refs. London, 1954.

Semliki Forest virus was first isolated from a pool of [mosquitos of the group of] *Aëdes abnormalis* (Theo.) in western Uganda [*R.A.E.*, B **34** 87] and a strain of the same virus was isolated from *Eretmapodites grahami* Edw. at Kumba [in the British Cameroons in 1948]. It therefore seemed probable that the virus is transmitted by mosquitos in nature, but direct evidence of this was lacking. An account is given of experiments on its transmission by *A. aegypti* (L.). Batches of 500–2,000 females were fed on infected hens' eggs [**43** 21], and the virus contents of pools of 20 were estimated on the next day and subsequently by titration in mice, while other groups were allowed to feed on anaesthetised mice. The virus content of the mosquito pools always fell in the first 24 hours and then rose to a peak on the tenth day. However, the peak was never significantly higher than the initial titre. The mosquitos transmitted the disease to the mice by biting, but only from the sixth to the ninth days. Ability to transmit seemed to be related to the peak, rather than to the actual virus level. The

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virus could not be passaged serially in the mosquitos, and it did not pass transovarially to the next generation. As it did not multiply in the mosquitos, *A. aegypti* is not thought to be of significance in its transmission.

HORSFALL (W. R.). **Mosquitoes: their Bionomics and Relation to Disease.** —9¼ × 6 ins., viii + 723 pp., 78 pp. refs. New York, N. Y., Ronald Press Co., 1955. Price $16.

The main part of this book (560 pages) comprises a systematically arranged review of most of the species of mosquitos (CULICINAE) of the world, with concise summaries of existing information on their distribution and habitats, and, in the case of the better known species and their varieties, on life-history, habits, parasites, predators and relation to disease. Authorities for statements made are given. The treatment of the species is preceded by more general treatment of the subfamily and each genus, presented on the same lines, and a large amount of information on the parasites and predators of mosquitos in different stages, the relation of the various species to the causal agents of disease and a number of other subjects is condensed in tables.

A glossary of some of the terms that have been used in connection with mosquitos, a list of references to techniques for studying bionomics in the different stages, and a bibliography of 78 pages are appended, together with a general index and a complete index of genera and species, including species not discussed in the book, which serves as a check-list of the subfamily.

REMPEL (J. G.). **The Mosquitoes of Saskatchewan.**—*Canad. J. Zool.* **31** no. 4 pp. 433–509, 1 pl., 156 figs., 47 refs. Ottawa, 1953.

In view of an epidemic of western equine encephalitis in Saskatchewan in 1941, in which there were more than 500 cases in man, 73 per cent. during the second half of August, extensive studies of the mosquito fauna of the area in the prairie in which the outbreak had been most severe were made during 1942–52, with supplementary observations in the aspen-grove and coniferous-forest zones farther north. The mosquitos found comprised 25 species of *Aëdes* and 12 species belonging to six other genera; keys to the genera and species are given, with descriptions of the latter and notes on their bionomics and distribution, their relative prevalence in the three ecological zones, their seasonal occurrence, and adaptations that affect their survival. The keys and descriptions apply to adults only, as the larvae were dealt with in a previous paper [*R.A.E.*, B **39** 73]. The most abundant species in all zones belonged to the genus *Aëdes*; *Culex tarsalis* Coq. and *Culiseta inornata* (Will.) were also common in the prairie zone but not elsewhere, and all other species were rare.

The western equine virus was first recognised in Saskatchewan in 1935; it caused epizootics in horses in 1935, 1937 and 1938 and sporadic infections in horses in 1936 and in man in 1935 and 1938. The epizootic of 1938 was especially severe, with some 50,000 equine cases, and vaccination was then undertaken on a large scale. There was no epizootic or epidemic in 1939 or 1940, and there were relatively few cases in horses during the epidemic in 1941. The epizootics of 1935 and 1937 both spread from the south-eastern corner of the Province, but the disease appeared in widely separated areas in 1938 and appeared to be locally acquired. After 1941, there were no further large-scale outbreaks in man or horses, though local ones, which were sometimes severe, occurred in each season.

The relation of weather conditions to the incidence of the disease and its presumed transmission by mosquitos is discussed. Cases in all years were most numerous in the second half of August and first half of September, the period at which the mosquitos that have more than one generation a year are most numerous in favourable seasons, and all the outbreak years were warm. Rainfall was normal or above normal in 1935, 1938 and 1941, but 1937 was a year of drought, and mosquitos were at times unusually abundant in 1942, when no outbreak of the disease occurred. *Culex tarsalis*, which is generally considered to be the most important vector [*cf.* **41** 127, etc.], was collected from four places in the prairie zone and two in the aspen-grove zone and is probably present at several localities in south-western Saskatchewan. It usually breeds in small weed-grown ditches, often in association with *Culiseta inornata*, which is regarded as a potential vector [*cf.* **36** 194]. These ditches become filled with water to a depth of 6–12 inches after rain and dry out after a few weeks, during which, however, the water becomes warm enough for the mosquitos to complete a generation. Although the adult female is generally regarded as the overwintering stage, overwintering females are rarely encountered and no larvae were found in Saskatchewan until early July; in dry seasons this mosquito appears to be absent. *C. inornata* is common in the prairies of Manitoba, Alberta and Saskatchewan, and also occurs in the aspen-grove zone of Saskatchewan. The females are the mosquitos most commonly found in autumn seeking winter quarters in houses. Adults of the first generation appeared as early as the end of May, and subsequent generations overlap. Breeding occurs extensively during June–August in shallow, water-filled grassy depressions varying considerably in type of vegetation. This mosquito, which in some seasons is abundant and in others appears to be absent, does not annoy man, but may severely attack stock on occasion.

Rozeboom (L. E.) & Gilford (B. N.). **Sexual Isolation between Populations of the *Culex pipiens* Complex in North America.**—*J. Parasit.* **40** no. 3 pp. 237–244, 8 refs. Lancaster, Pa., 1954.

There are at least three recognisable populations of mosquitos of the complex of *Culex pipiens* L. in the United States [*R.A.E.*, B **40** 64]; they are typical *pipiens*, *fatigans* Wied. (*quinquefasciatus*, auct.) and *molestus* Forsk. Investigations [**40** 64, 67, 187; **41** 15] have led the authors to consider that *pipiens* and *fatigans* are subspecies, but they prefer to regard *molestus* as a " biotype " in that it appears to represent a group of variant individuals, which may breed true in the laboratory, or under special conditions in nature, so long as mechanisms for the selection of autogenous individuals remain in operation. Attempts to find any genetic or other barrier between the populations have been unsuccessful, but they seem to maintain themselves as fairly distinct entities in nature, and a study was therefore undertaken to determine whether there was any mating barrier between them.

The mosquitos used were reared from pupae taken from four laboratory colonies and comprised strains of *pipiens* and *molestus* from Maryland and strains of *fatigans* from Texas and Alabama. They were isolated by strain and sex till they were 1–3 days old and were then allowed to pair in cages, in each of which ten males were kept with 50 females for 2–4 days. Most of the cages had a capacity of 1 cu. ft.; larger ones were used in a few replicates without affecting the results. The females of the strains were

differentially marked before the experiments and dissected after them, and the criterion for mating was the presence of spermatozoa in the spermathecae. The experiments were of two kinds, selection experiments, in which 25 of the females in the cage belonged to the same strain as the males and 25 to another strain, and non-selection experiments, in which all 50 belonged to a single strain. All possible combinations were tested in the selection experiments, including that between the two *fatigans* strains, and the results are given in tables and discussed.

The results of five of the six selection experiments all showed the same trend; in each the percentage of homologous matings was the higher for males of one of the two strains under test and the percentage of heterologous matings was higher for males of the other strain. All these differences in percentages were highly significant. The remaining selection experiment was that with *pipiens* and Texas *fatigans*; in it homologous mating predominated with males of both strains, but the difference was not significant with the *pipiens* males. These results could not be explained by any ability of the sexes of a strain to recognise and select one another and confirmed previous ones [**40** 64] in this respect. They could, however, be explained by differences in the sexual activity of the strains, and these were further evidenced by differences, considerable in some of the tests, between the total percentages of females inseminated by the males of the two strains and between the percentages of females of the two strains inseminated by the males of both. Absence of strain preference and differences in sexual activity were also evident in the non-selection experiments, since the males of less active strains inseminated more females of more active strains than females of their own.

In these experiments, *molestus* was much the most active strain and *pipiens* the least, and a small difference was noted between the two strains of *fatigans*. The stimuli that would induce maximum mating responses in *pipiens* were evidently lacking in the laboratory but must exist in its natural environment, and it is possible that the different populations become sexually active in slightly different circumstances. Such differences in activity would tend to keep the populations partly separated where their ranges overlap.

VAN THIEL (P. H.). **Trematode, Gregarine and Fungus Parasites of *Anopheles* Mosquitoes.**—*J. Parasit.* **40** no. 3 pp. 271–279, 4 figs., 23 refs. Lancaster, Pa., 1954.

Papers on trematodes found in mosquitos, chiefly larvae, of the genus *Anopheles*, and particularly a series [*R.A.E.*, B **10** 201; **13** 182; **19** 189] in which the life-cycle of one of the species is elucidated, are reviewed because they have escaped attention in recent literature.

A gregarine found in a female of *Anopheles farauti* Lav. in Netherlands New Guinea is described as *Diplocystis metselaari*, sp.n., and one described by H. P. Johnson (1902) from a species of *Anopheles* in Massachusetts is named *D. johnsoni*, sp.n.

Manalang found sporangia of *Coelomomyces*, which he considered to be coccidia, in the body cavity of adults of all the common species of *Anopheles* in the Philippines and in a single larva of *A. tessellatus* Theo. [**18** 209]. Walker [**27** 65], in Sierra Leone, discovered sporangia of four types in adults of *A. gambiae* Giles infected in nature or reared from infected larvae, and particularly in the ovaries of the females, which were sterilised by them. He named one of these types (type 3) *C. africanus*, but did not name the others. The author describes sporangia that he found completely

filling the ovaries of two females of *A. tessellatus* in Java and considers that they and Walker's type 1 belong to the same species, which he names *C. walkeri*, sp.n. He also believes that Walker's type 4 and Manalang's sporangia are a single species, which he names *C. ascariformis*, sp.n., and that Walker's type 2 is identical with type 3 (*C. africanus*).

CHRISTIE (M.). **The Mode of Action of Oil Solutions of DDT used as Mosquito Larvicides.**—*Ann. trop. Med. Parasit.* **48** no. 1 pp. 11–14, 2 figs., 1 ref. Liverpool, 1954.

The mode of entry of oil solutions of DDT into Anopheline larvae was investigated in two experiments in which fourth-instar larvae of *Anopheles gambiae* Giles were used. In the first, the larvae were held down under water, by pins crossing above the neck, in such a way that the spiracular plate was at the surface and could not be brought in contact with the mouth-parts. An oil of high spreading capacity, used alone or with 5 per cent. DDT, was applied to the water at the rate of 1 qt. oil (2 oz. DDT) per acre, equivalent to an oil film 0·29μ thick, and made to flow off the surface two hours later by overfilling the dish with water run in through a fine tube. The larvae were washed in two changes of water and then released in clean water. When examined 22 hours later, ten of 11 that had been pinned down but given no insecticidal treatment and ten of 11 that had been treated with oil only were alive, but all of 13 treated with DDT were dead.

Free-swimming larvae exposed to DDT in an oil film often sink to the bottom of the container and nibble at the comb and spiracular plate, as if to clean them. It was therefore possible that the larvae exposed to DDT in the test might have transferred the DDT from the spiracular plate to the mouth-parts and so ingested it while they were free in the clean water. As larvae kept pinned down did not survive for 24 hours, another technique, which is described, was used for the second test. The end of a glass tube was drawn out to form an aperture just large enough to permit passage of the abdomen and relatively deformable thorax, but not the rigid head-capsule, when the larva was introduced into the tube with the tail towards the narrow end and gentle air pressure was applied. The tube, with the imprisoned larva, was placed vertically in a jar and the initial procedure of the first experiment was followed, but after the oil had been made to flow off, the water level was lowered again with a siphon until the spiracular plate appeared at the surface, and the larva was left for 22 hours. In this experiment, 14 of 15 larvae exposed to DDT died in 24 hours, as compared with only two of 15 exposed to oil alone. It is concluded that, at full dosages of DDT, larvae of *A. gambiae* can acquire a lethal dose through the spiracular plate, but it is not known whether the gut or the spiracular apparatus is the more important route of entry in free-swimming larvae.

HEISCH (R. B.). **Transmission Experiments with *Spirochaeta dipodilli* Heisch, 1950.**—*Ann. trop. Med. Parasit.* **48** no. 1 pp. 28–32, 5 graphs, 1 ref. Liverpool, 1954.

Spirochaeta dipodilli, which was isolated in Kenya from *Ornithodoros erraticus* (Lucas) and pygmy gerbils (*Dipodillus*) in burrows near larger ones dug by ant-bears and infested with *O. moubata* (Murr.) [*R.A.E.*, B **41** 9], was thought to be possibly an evolutionary precursor of *S. duttoni*, although it was not readily transmitted by *O. moubata* and appeared to be

only slightly pathogenic to man [*loc. cit.*]. Moreover, no spirochaetes have ever been found in *O. moubata* from burrows [*cf.* also **43** 42].

In further experiments two adult Africans on whom *O. erraticus* from pygmy-gerbil burrows were allowed to feed and three others inoculated with blood from one of them when it contained spirochaetes all developed symptoms of relapsing fever, which were, however, milder in all cases than those caused by *S. duttoni* and milder in the inoculated patients than in those infected by the ticks. Spirochaetes were found in the blood of all, though only in small numbers. Two other Africans developed mild attacks of relapsing fever after collecting *O. erraticus* from burrows of pygmy gerbils, and it is thought that infection was transmitted to them by nymphs, which are often fairly numerous in the burrows. Examples of *O. moubata* from a laboratory colony failed to transmit *S. dipodilli* from a heavily infected rat to a rat or a man, or to a rat from one of the Africans experimentally infected by *O. erraticus*, but when they were emulsified and inoculated into healthy rats some of the latter became infected. Examples of *O. moubata* collected from large burrows fed reluctantly on infected rats or a healthy one, those that might have fed twice did not transmit the spirochaete, and none infected rats when emulsified and inoculated.

Lewis (D. J.) & Kirk (R.). **Notes on the Phlebotominae of the Anglo-Egyptian Sudan.**—*Ann. trop. Med. Parasit.* **48** no. 1 pp. 33–45, 2 figs., 8 maps, 17 refs. Liverpool, 1954.

A list is given of 49 species and varieties of *Phlebotomus* known from the Anglo-Egyptian Sudan [*cf. R.A.E.*, B **39** 49, etc.], with notes on their distribution and relation to disease. *P.* (*Spelaeomyia*) *darlingi*, sp. n., is described from a single male taken in a cave; *Spelaeomyia* was erected by Theodor as a subgenus of *Sergentomyia* [**36** 133], but, like the latter, is here regarded as a subgenus of *Phlebotomus*.

Sandfly fever appears to be endemic in the northern riverain area, where *P. papatasi* (Scop.) is abundant; cases are not common in the native population, but usually occur among newly arrived British residents and there have been epidemics from time to time among British troops stationed at Khartoum.

Cutaneous leishmaniasis of the oriental-sore type occurs in riverain areas north of Khartoum and in Darfur, where also *P. papatasi* is common, and cutaneous lesions are found in the Nuba Mountains, the Blue Nile region, and other districts within the areas in which visceral leishmaniasis (Sudan kala-azar) is endemic [*cf.* **28** 201], but may be a concomitant of the kala-azar. No cases of cutaneous leishmaniasis have been reported from the area infested by *P. roubaudi* Newst., which has been considered a probable vector in the Niger region [**32** 213].

P. orientalis Parr. occurs in all the important kala-azar areas in the Sudan except the south-eastern one (round Kapoeta), and has been regarded as the vector in the north-east [*cf.* **28** 201]. Other sandflies that belong to the subgenus *Phlebotomus* and so might include vectors are *P. lesleyae* Lewis & Kirk and *P. rodhaini* Parr., which occur in small numbers in more than one of the endemic areas in the northern Sudan, *P. martini* Parr. which was found only on an isolated hill in the north-east, and *P. roubaudi* var. *fourtoni* Floch & Abonnenc, *P. alexandri* Sinton, *P. martini*, *P. rodhaini*, *P. longipes* Parr. & Martin and *P. sergenti* var. *saevus* Parr. & Martin, which are present in the south-eastern endemic area, though the last two were found only in an isolated mountain locality from which there are no

records of leishmaniasis. It is possible, however, that *P. clydei* Sinton, which appears to occur throughout the Sudan, except in the extreme south-west and the driest parts of the northern desert, may be concerned in transmission although it belongs to the subgenus *Sintonius*, since it is present wherever visceral leishmaniasis is prevalent, is frequently taken in traps in animal burrows, and on occasion attacks man [**38** 218]. In experiments in which the sandflies were fed on hamsters infected with visceral leishmaniasis and on Sudanese patients with post-kala-azar dermal leishmaniasis, the percentages that became infected were 1·8 in *P. clydei* and about 7 in *P. orientalis* and *P. papatasi*. The conditions of the tests were not identical, however, and it is estimated that the chance of infection in the *P. orientalis* was only 5 per cent. of that in *P. papatasi* or *P. clydei*. Flagellates in the " anterior " position were found in *P. orientalis* and in one instance in *P. clydei*, but not in *P. papatasi*.

Davies (A. M.) & Yoshpe-Purer (Y.). **Observations on the Biology of West Nile Virus, with special Reference to its Behaviour in the Mosquito** *Aëdes aegypti*.—*Ann. trop. Med. Parasit.* **48** no. 1 pp. 46–54, 3 graphs, 25 refs. Liverpool, 1954.

Details are given of experiments, mainly including or confirming those already noticed [*R.A.E.*, B **43** 21, 65], on the transmission by *Aëdes aegypti* (L.) of various lines of strains of the West Nile virus isolated in Egypt or Israel, the multiplication of the virus in the mosquito and its distribution in various parts of its body. Pools of ten larvae, eight pupae and six adults that were the offspring of infected females did not infect young mice into which they were injected, indicating that transovarial passage of the virus had not occurred. In other tests, the susceptibility of golden hamsters [*Cricetus auratus*] to the virus [**31** 203] was confirmed, but white rats and cotton rats [*Sigmodon hispidus*] were found to be resistant to it.

Gillies (M. T.). **The Recognition of Age-groups within Populations of** *Anopheles gambiae* **by the Pre-gravid Rate and the Sporozoite Rate.**—*Ann. trop. Med. Parasit.* **48** no. 1 pp. 58–74, 4 graphs, 21 refs. Liverpool, 1954.

Most of the following is based on the author's summary of this paper; the observations recorded in it were made at Tengeni, a small village in the low-lying area of Tanganyika [*cf. R.A.E.*, B **42** 113, 118]. It has been found that females of *Anopheles gambiae* Giles normally require two blood-meals to complete the first gonotrophic cycle, that females that have nearly digested a blood-meal can be separated into groups, designated gravid and pre-gravid, according to whether the ovaries are completely or partly developed, and that most of the pre-gravid females are newly emerged. The pre-gravid rate thus serves as an approximately accurate index of the proportion of newly emerged females in the biting population; it is determined by collecting females that have fed during the previous night, keeping them for 24 hours (or for two days where the gonotrophic cycle requires three) and then examining them under a hand lens, when the pre-gravid females can be recognised by the relatively collapsed state of the abdomen. The validity of the method is discussed with particular reference to the percentage of fertilised females included in the pre-gravid rate and the proportion of these that are newly emerged, to qualitative changes in the

ovaries and oviducts, and to the relationship between rainfall and the subsequent pre-gravid rate; and observations in which it was used to study the daily fluctuations in the proportions of newly emerged females at Tengeni are described. The newly emerged group can also be recognised by the degree of ovarian development in females dissected shortly after feeding.

The sporozoite rate in gravid females was adopted as a measure of the malaria infectivity of the mosquito populations studied. Monthly values of this index in *A. funestus* Giles over a period of eight months varied only between 1·5 and 3·3 per cent. This finding is taken as strong evidence that the density of human infectors (gametocyte carriers) had remained more or less constant throughout the period. The sporozoite rate in *A. gambiae* varied inversely with the size of the biting population [*cf.* **36** 98]. Fortnightly values ranged from 2·5 to 15·4 per cent., and even greater fluctuations were observed at weekly intervals. Age-group changes within the population are held to be responsible for such short-term fluctuations, in contrast to the extrinsic factors determining the average level of the sporozoite rate.

The composition of 21 successive weekly samples of the population is analysed in terms of three age-groups (pre-gravid, uninfective gravid and infective gravid). The analysis demonstrates the instability and the constantly changing age-composition of the population of *A. gambiae* in the area studied. For a proper assessment of the infective potentialities of the species, analysis of transmission needs to be carried out over an extended period.

Hutchinson (M. P.). **The Epidemiology of human Trypanosomiasis in British West Africa. III. Sierra Leone.**—*Ann. trop. Med. Parasit.* **48** no. 1 pp. 75–94, 2 pls., 3 maps, 29 refs. Liverpool, 1954.

This third part of a series on sleeping sickness in British West Africa [*cf. R.A.E.*, B **42** 199] deals with its epidemiology in Sierra Leone, the topography, climate and socio-economic conditions of which are described. It is caused exclusively by *Trypanosoma gambiense*, as in the rest of West Africa, and *Glossina palpalis* (R.-D.) is the only vector in Sierra Leone. The country comprises a mangrove belt along most of the coast and the lowest reaches of the main rivers, and belts of secondary forest and savannah, with a transition zone between them. The secondary forest, which ranges from dense evergreen thicket to stunted woodland, and the transition zone cover most of it. *G. palpalis* occurs everywhere, but is numerous only along creeks and at river-mouths in the coastal region, where it feeds in the mangrove belt and breeds in the vegetation fringing the dry land. It is scarce in the savannah of the north, where the riverine vegetation often affords insufficient protection against forest fires in the dry season, and also in the area of dense evergreen thicket, where it occurs along the main rivers but is frequently absent from the small side streams. It is more plentiful in the transition zone, where it finds shelter in the vegetation along the streams and food in the adjoining grassland and farmland. The climate of the dry season is not, in general, severe enough to affect it adversely, but its breeding in the long rainy season is reduced by the heavy rainfall and frequent flooding of the rivers, which make the soil waterlogged over wide areas, and its activity by long periods of cloud.

Sleeping sickness was of little importance until 1939, when an epidemic, which quickly became severe, affected two tribes in the south-east. The disease was apparently introduced from French Guinea and Liberia and its spread was favoured because the area concerned, which was one in which

the secondary forest gave way to the transition zone, contained many small streams that harboured *G. palpalis*, most of the villages were near them so that contact with the fly was close and continuous, and the human populations were high and at a low level of resistance, with much interchange between them. The epidemic was effectively controlled in three years by mass treatment of cases, except in one district where mass prophylaxis also had controlled it by 1949, and continuance of precautionary surveys and treatments reduced the incidence of infection to 0·2 per cent. in 1951. A small fresh outbreak occurred in 1947–48 in an area of much denser secondary forest and evergreen thicket to the south. It differed from the main one in that it was strictly localised, the incidence of infection varied greatly from village to village, and a single mass treatment effected spectacular control. It would thus appear that the risk of further outbreaks in Sierra Leone is greatest in the transition zone, which is being enlarged especially in the central districts, as a result of increasing populations, extensive deforestation, cultivation of unsuitable areas, and grass fires. Outbreaks might also develop in the areas of evergreen thicket, but would there be localised and easily controlled. In the other vegetational zones, continuous close contact with the vector does not normally occur, though the disease has been present in low endemic form for many years on Sherbro Island, off the south-west coast. Eradication of *G. palpalis* is economically impracticable in the transition zone and unjustifiable in the savannah and mangrove belts; in the latter, it has been eliminated incidentally where areas have been cleared for the cultivation of swamp rice. Aggressive clearing against it is not advisable in the zone of secondary forest and evergreen thicket, but obstructive clearing [*cf.* **42** 157] might prove of great value.

Kershaw (W. E.), Crewe (W.) & Beesley (W. N.). **Studies on the Intake of Microfilariae by their Insect Vectors, their Survival, and their Effect on the Survival of their Vectors. II. The Intake of the Microfilariae of *Loa loa* and *Acanthocheilonema perstans* by *Chrysops* spp.**—*Ann. trop. Med. Parasit.* **48** no. 1 pp. 102–109, 2 figs., 4 refs. Liverpool, 1954.

This paper, which is the second of a series [*cf. R.A.E.*, B **42** 202] is a report of experiments in the British Cameroons in which 55 examples of *Chrysops silacea* Aust., collected in the field when about to take a blood-meal, were allowed to feed on people whose blood contained microfilariae of both *Loa loa*, which is transmitted by this Tabanid, and *Acanthocheilonema perstans*, which is not, and the actual intake of the microfilariae by each fly was compared with the expected intake [*loc. cit.*]. It was found that the intake of the *loa* microfilariae varied widely. Most of the flies contained fewer than the expected number, whether the latter was large or small; only a few contained more. The actual intake of *perstans* microfilariae approximated to the expected intake.

Since *Chrysops* feeds from a pool of blood [*cf.* **40** 9, 150] and not direct from a capillary, the intake of microfilariae by it must depend on their numbers in the blood-pool. It is suggested that the variation in the numbers of microfilariae of *L. loa* in the pools [*cf.* **42** 167] may be due either to an irregularity in their concentration in the small individual capillaries in the dermis [*cf.* **28** 124], or to a delay in the accumulation of representative numbers in the rapidly spreading pool, owing to their large size, their slow movements, and the varying size of the laceration. The number of microfilariae of *L. loa* taken in by an individual fly cannot therefore be calculated

from the size of the blood-meal and the concentration of the microfilariae in the blood-donor's peripheral circulation.

KERSHAW (W. E.) & NICHOLAS (W. L.). **Studies on the Epidemiology of Filariasis in West Africa, with special Reference to the British Cameroons and the Niger Delta. V. The Intensity of Infections with *Loa loa* and with *Acanthocheilonema perstans* in the Rain-forest, the Forest Fringe and the Mountain Grasslands of the British Cameroons, and its Relation to the Incidence.**—*Ann. trop. Med. Parasit.* **48** no. 1 pp. 110–120, graphs, 14 refs. Liverpool, 1954.

The following is almost entirely based on the authors' summary. The results are recorded of investigations into the intensity of infection with *Loa loa* and with *Acanthocheilonema perstans* (as measured by the number of microfilariae in 50 cu. mm. of peripheral blood) in the different age-groups of the population in the rain-forest, the forest fringe and the mountain grasslands of the British Cameroons, and it is shown that the intensity of the infections is related to their incidence [*cf. R.A.E.*, B **43** 43]. Factors that may affect both as measured by the appearance of microfilariae in the peripheral blood are discussed. They include the transfer of the infective larvae by the vector fly to an individual, the load of adult worms in the individual, and the production, appearance and survival of the microfilariae. In connection with the first of these, it is pointed out that there are no accurate records of differential biting rates in infants, children or adults [*cf.* **43** 47] for either *Chrysops* spp. or *Culicoides* spp., but, in many rain-forest villages examined, all members of the population were repeatedly bitten by *Chrysops* spp., of which 5 per cent. harbour infective forms of *L. loa*, and any differential biting rate of *Culicoides* spp. is insufficient to prevent the establishment of infection by *A. perstans* in childhood.

In the rain-forest, the intensity of infection with *L. loa* in the human host shows no evidence of a suppressive factor that might reduce the microfilariae to some limited number. In infections with *A. perstans*, the numbers of the microfilariae are suppressed until early adult life but increase with further continuous exposure. In the forest fringe, though the incidence of infection with *L. loa* falls, the intensity of the infection in infected individuals is not reduced. In infections with *A. perstans*, the incidence begins to decline before that of *L. loa* and continues to do so, though at a slower rate, and the intensity of infection is reduced in all age-groups. The difference in behaviour of the two combinations of parasite and definitive host is discussed, and the modes of action of the postulated suppressive mechanism are contrasted. The incidence and the intensity of the infections are considered as measures of the level at which equilibrium may be attained in differing circumstances.

THOMSON (R. C. MUIRHEAD-). **The Identity of " Eye-flies " in Assam.**—*Ann. trop. Med. Parasit.* **48** no. 1 p. 121, 1 ref. Liverpool, 1954.

The name " eye-fly " has been used in Assam not only for *Siphunculina funicola* (de Meij.), which is attracted to ulcers and discharges from the eye or nose and is associated with Naga sore and epidemic conjunctivitis [*R.A.E.*, B **16** 252], but also for a Ceratopogonid of which specimens caught in January, February and June 1938–39 were identified as *Lasiohelea lefanui* (Carter) var. *squamipes* I. & M. This midge hovers before the eyes with erratic movements, unlike the leisurely ones of *Siphunculina*, and eventually

bites the ears or the back of the neck. Records of eye-flies in the absence of ulcers or discharges from the eyes or nose probably refer to it.

Schmiedeberg (J.) & Wasserburger (H. J.). **Die akute Giftigkeit des Hexachlorcyclohexan für den Menschen.** [The acute Toxicity of BHC to Man.]—*Anz. Schädlingsk.* **26** pt. 9 pp. 129–133, 33 refs. Berlin, 1953.

Details are given of five cases in which BHC smoke tablets were swallowed by young children and resulted in mild symptoms of poisoning that were easily treated by the usual methods, and of an experiment in 1951, in which the junior author, a healthy man 32 years of age weighing 59·1 kg., swallowed 1 gm. pure γ BHC dissolved in 5 ml. vegetable oil with a slice of dry bread about two hours after a light meal. Symptoms, including dizziness and headache, appeared 30 minutes later, followed after 2½ hours by severe symptoms leading to unconsciousness. This phase lasted 15 minutes, after which an improvement set in. A second, more serious attack occurred 5½ hours after the first and was accompanied by tremors, foaming at the mouth and unconciousness. Death appeared likely to ensue, and treatment was applied. This consisted of blood-letting and infusion of saline with grape-sugar solution, followed by blood transfusions on the two subsequent days. Recovery was complete. There were no gastro-intestinal symptoms and no rise in temperature. BHC was demonstrated in the blood two hours after administration, but could not be shown in the urine. It is concluded that the dose of nearly 17 mg. per kg. body weight was close to the lethal dose. The treatment of BHC poisoning is briefly discussed.

Melis (R.) & Beccari (F.). **Osservazioni sull'effetto chemioterapico degli insetticidi organo-fosforici sulla scabbia del coniglio da** *Sarcoptes scabiei* **var.** *cunicoli* **L. Nota I. (Azione delle piccole dosi somministrate quotidianamente per via parenterale.)** [Observations on the chemotherapeutic Effect of organo-phosphorous Insecticides on Rabbit Mange caused by *Sarcoptes cuniculi*. Note I. (The Action of small Doses administered daily by parenteral Injection.)]—*Redia* **38** pp. 145–161, 13 refs. Florence, 1953. **Nota II. (Azione delle dosi massive somministrate periodicamente per via parenteralein)** [Note II. (The Action of large Doses administered periodically by parenteral Injection.)]—*T. c.* pp. 169–180. (With Summaries in English.)

Accounts are given of experiments carried out in 1952 in which rabbits were treated by daily or weekly intraperitoneal injection of parathion in olive oil for the control of *Sarcoptes cuniculi* Neum., a very injurious parasite that usually kills its host in a few weeks [*R.A.E.*, B **17** 102]. In the tests described in the first paper, the treatments comprised daily injection for 30 days of 0·5, 0·25 or 0·1 mg. parathion per kg. body weight, and the rabbits were artificially infested. Rabbits that received the injections without having been infested were completely unaffected by the parathion, and six that were infested and not treated all died after 40–57 days. The other infested rabbits were divided into six groups of five; three groups (A, B and C) were treated with the 0·5, 0·25 and 0·1 mg. doses from the time when the first symptoms of mange appeared (after about three weeks), and three (D, E and F) were treated with the same doses when the infestation had reached an advanced stage (about five weeks after infestation). At the conclusion of the treatment, four group A rabbits were completely

healthy and the remaining rabbit of this group and one of group B showed very slight symptoms. These six rabbits were alive and well four months later and were the only ones that lived for more than 30 days. Three group B rabbits showed an improvement of symptoms but died 25–30 days later, while the remaining one and all those of group C showed an aggravation of symptoms and died in 2–13 days. The condition of the group D rabbits had not deteriorated at the end of the treatment, but all died within 22–28 days, and the rabbits of groups E and F lost condition and died in a shorter time, some before the treatment was completed.

In the experiments described in the second paper, healthy and severely infested rabbits were injected at weekly intervals, beginning on 1st July, with 10, 20 or 30 mg. parathion per kg. body weight in 5 cc. olive oil. All the healthy animals lost weight and died after 7–10, 3–6 and 2–6 injections of 10, 20 and 30 mg., respectively, and all the infested rabbits died between 15th July and 31st August, most of them having shown an aggravation of mange symptoms before their death.

Weyer (F.). **Vergleichende Untersuchungen über das Verhalten verschiedener Rickettsien-Arten in der Kleiderlaus.** [Comparative Investigations on the Behaviour of various Species of Rickettsiae in the Body Louse.]—*Acta trop.* **11** no. 3 pp. 193–221, 20 figs., 14 refs. Basle, 1954. (With Summaries in French and English.) **Unterschiede im Verhalten mehrerer Stämme von** *Rickettsia conori* **in der Kleiderlaus.** [Differences in the Behaviour of several Strains of *R. conori* in the Body Louse.]—*Z. Tropenmed. u. Parasit.* **5** pt. 4 pp. 477–482, 3 figs., 3 refs. Stuttgart, 1954. (With a Summary in English.)

The systematic position of many rickettsiae is uncertain but could perhaps be clarified by a knowledge of their behaviour in arthropod hosts. Observations have been made on the development of many strains of *Rickettsia quintana* and *R. prowazekii*, single strains of *R. mooseri*, *R. rickettsi*, *R. akari*, *R. orientalis* (*tsutsugamushi*) and *Coxiella burneti*, and strains of *R. conori* representative of Marseilles fever, South African tick-bite fever and Kenya tick-typhus, mainly in body lice [*Pediculus humanus humanus* L.] artificially infected by inoculation into the body cavity or rectum, and the results, some of which have already been noticed [*R.A.E.*, B **41** 101, 192; **42** 143], are summarised and compared in the first paper. All the rickettsiae investigated except *R. orientalis* and *R. quintana* survived and increased in the haemolymph and fat-body of larvae of *Tenebrio molitor* L. and in the tick, *Ornithodoros moubata* (Murr.). When injected into the body cavity of the lice they all multiplied in the haemolymph, and could be cultivated in it indefinitely, except *R. orientalis*, which died out in a month. Most of the rickettsiae developed extracellularly in the haemolymph but passed in some of the lice from the body cavity into the stomach cells and developed intracellularly. *C. burneti* also attacked other cells.

All except *R. orientalis* could be established in the stomach of the lice by rectal inoculation and multiplied there. The development of *R. quintana* was extracellular in the lumen, whereas that of the others was intracellular in the epithelium. In some lice that had been infected for a considerable time, the rickettsiae passed from the stomach cells to the haemolymph and, in the case of *C. burneti*, to other cells.

R. quintana was not pathogenic for the louse, and *C. burneti* was only slightly so. Infection with *R. akari* and the South African and Kenya strains of *R. conori* was usually without serious effect. The pathogenicity of *R. prowazekii* and *R. mooseri*, which is generally rated high, varied with

the strain concerned. *R. rickettsi* and the Marseilles-fever strain of *R. conori* showed the highest pathogenicity of all, and the louse is biologically unsuited as a host for them. The rickettsiae can be classified to some extent according to their behaviour in the louse. *R. quintana*, *R. orientalis* and *C. burneti* are exceptions, their development having proceeded along independent lines, but *R. prowazekii*, *R. mooseri*, *R. akari* and the South African and Kenya strains of *R. conori* form one more or less closely allied group and *R. rickettsi* and the Marseilles-fever strain of *R. conori* form another. Many strains of *R. prowazekii*, *R. mooseri* and *R. quintana* have been investigated with largely the same results, and their behaviour can be considered specific, but investigations on other strains of the remaining species are desirable before the same can be assumed for them.

The experiments with the Kenya strain of *R. conori* in the lice are described in greater detail in the second paper, and the results compared with those obtained for the South African and Marseilles-fever strains.

Schlossberger (H.), Betzel-Langbein (H.) & Kreuz (G.). **Über die Epidemiologie der Leptospirosen.** [On the Epidemiology of the Leptospiroses.]—*Acta trop.* **11** no. 3 pp. 300–302, 2 figs., 5 refs. Basle, 1954.

Nymphs of *Ornithodoros moubata* (Murr.) were allowed to feed on a guineapig infected with a laboratory strain of *Leptospira icterohaemorrhagiae*, the causal agent of infectious jaundice (Weil's disease). After 30 minutes they were crushed, and a suspension of them was injected intraperitoneally into a healthy guineapig, which developed the disease in three days. Similar results were obtained when the ticks were crushed at intervals of up to 39 days after the infecting meal. The eggs laid by 15 infected ticks (about 1,000–1,200) also caused the disease when washed in lukewarm water, crushed, and injected into the abdominal cavity of a young guineapig. In a test for direct transmission, ticks were allowed to feed on an infected guineapig and again after 31 days on a healthy one. The latter contracted the disease within seven days. At the time of feeding, the ticks secreted an albuminous substance from the coxal glands that came into contact with the wound caused by the mouth-parts and so for a short time with the blood stream of the host. Intraperitoneal injection of coxal fluid collected from feeding ticks caused the disease in a young guineapig.

Montalván C. (J. A.). **Ensayos de profilaxis de enfermedad de Chagas en Guayaquil.** [Experiments on the Control of Chagas' Disease in Guayaquil.]—*Rev. ecuat. Hig. Med. trop.* **8–9** (1951–52) no. 1–4 pp. 23–28, 1 map, 5 refs. Guayaquil [1953].

Chagas' disease [caused by *Trypanosoma cruzi*] has been recognised in Ecuador since 1929. The principal focus is Guayaquil, which is surprising, since the Triatomine vectors are predominantly rural in habit, but it is thought that they are attracted to the city by artificial light and find favourable breeding sites in the numerous wooden houses present. Since BHC applied for the control of mosquitos appeared to have some effect on the bugs, a sector of the city in which the bugs were numerous and cases of the disease had occurred for several years was selected for an experiment, and the walls of 4,016 rooms in 248 houses were sprayed with γ BHC at the rate of 400 mg. per sq. m. in wettable powder or kerosene solution. The walls were cleared for spraying, and wallpaper was in many

instances removed to expose cracks and other refuges. In the course of the work, 729 Triatomines were taken in 116 houses. Four months after treatment, 120 of the houses were inspected, and only one Triatomine (a nymph) was found. The cost of the spraying was high in relation to the importance of the disease.

MONTALVÁN C. (J. A.). **Campaña antipalúdica en el Ecuador. Métodos empleados y resultados obtenidos.** [A Malaria Campaign in Ecuador. Methods used and Results obtained.]—*Rev. ecuat. Hig. Med. trop.* **8–9** (1951–52) no. 1–4 pp. 34–90, 12 pls., 2 maps (1 fldg.), 9 refs. Guayaquil [1953].

Malaria occurs in Ecuador both in the coastal lowlands and in the valleys of the Andes. The main vector in the lowlands is *Anopheles albimanus* Wied., which breeds in many types of water and becomes numerous during the rainy season, from early February to the middle or end of April. Primary infections are recorded from late February to May, cases at other times of the year being due to relapse. Other vectors present are *A. pscudopunctipennis* Theo. and *A. punctimacula* D. & K., but these are normally of little importance. The chief vector in the mountains is *A. pseudopunctipennis*, which breeds in pools of clear water containing algae [*cf. R.A.E.*, B **39** 73], but *A. albimanus* is also of importance in valleys in which the temperature is high and the rainfall similar to that of the coast. Transmission occurs almost throughout the year.

Previous work on the control of these Anophelines is reviewed, and an account is given of a campaign begun in 1949 for the eradication of malaria from Ecuador by control of Anophelines in houses. Workers were specially trained, and the country was divided into zones and sectors, the latter comprising some 1,000–2,000 houses each, which were carefully surveyed. The insecticide used was almost exclusively DDT, and this was applied in kerosene solution or wettable-powder sprays to leave deposits of 2 gm. per sq. m., beginning in November 1949. The whole of the interior of the houses, including space beneath floors when accessible, and outhouses, and the exteriors of doors and windows were treated up to a height of nearly 12 ft. from the ground, and ceilings were included if they came within this limit. Treatment was repeated in November 1950 and again in November 1951, when the rate of deposit was reduced to 1·5 gm. per sq. m. The organisation of the work is described in detail, and tables show the costs incurred and the number of houses treated; these comprised all those present in many sectors.

The results were assessed from the malaria indices, since it was not expected that the Anophelines would be eradicated. Surveys showed that the parasite indices were reduced by 90 per cent. as compared with those found in 1948, and the index for 1952 was only 1·3 per cent. both during the period of transmission and at other times of the year, indicating that most of the cases recorded were due to old infections. There were no cases in 1951–52 among babies born since the beginning of the campaign, so that transmission must have been practically suppressed. Spleen indices and mortality due to malaria were also greatly reduced.

Although *A. albimanus* and *A. pseudopunctipennis* are not particularly domestic in habit, their density was much reduced by the campaign, the numbers of Anophelines taken in traps containing animals in the environs of Guayaquil averaging 2·05 in 1943, 2·3 in 1950 and 0·38 in 1952. Subsidiary tests showed that the DDT deposits usually remained effective for five months.

Espinoza B. (L.). **Infección experimental del** *Panstrongylus chinai* **por el** *Tripanosoma cruzi*. [Experimental Infection of *P. chinai* with *Trypanosoma cruzi*.]—*Rev. ecuat. Hig. Med. trop.* **11** no. 3 pp. 108–109, 1 pl. Guayaquil, 1954.

Panstrongylus chinai (Del Ponte) is common in parts of Ecuador, and since its domestic and semi-domestic habits make it a possible vector of *Trypanosoma cruzi*, its ability to transmit this trypanosome was tested. Six laboratory-bred adults were allowed to feed on a heavily infected white rat. Their excreta were negative ten and 18 days after feeding. Three were found dead on the 24th day, and developmental forms of *T. cruzi* were observed in excreta from them. Two days later, similar forms were observed in the excreta of the three survivors. The diluted excreta were injected intraperitoneally into two rats, and one of these that was sacrificed 26 days later showed leishmanioid forms in the heart tissue.

Ruiz (H.). *Rhodnius prolixus* **en Costa Rica (nota previa).**—*Rev. Biol. trop.* **1** fasc. 2 pp. 239–240, 1 fig., 1 ref. San José, Costa Rica, 1953.

Rhodnius prolixus Stål was not known to be present in Costa Rica until 1953, when 30 examples were taken in a straw hut in the neighbourhood of the airport at Liberia; 11 that were investigated showed no infection with *Trypanosoma* (*Schizotrypanum*) *cruzi*. Further examples were subsequently taken in the same general region.

Maillot (L.). **Les variétés de** *Glossina palpalis* **en Afrique equatoriale française.**—*Bull. Soc. Path. exot.* **46** no. 6 pp. 1066–1080, 1 pl., 13 figs., 22 refs. Paris, 1953.

Many varieties of *Glossina palpalis* (R.-D.) have been described by various authors. Some differ from the type form only in external characters such as colour and size, but others differ in the form of the genitalia. The latter include *G. palpalis* var. *quanzensis*, which was described by F. A. Pires in 1948 from the river Quanza in Angola, and the five subspecies recognised by Vanderplank [*R.A.E.*, B **40** 144], who described one from Angola as *angolensis* and also illustrated the male genitalia of a form from Leopoldville (Belgian Congo) that he considered intermediate between *G. p. palpalis* and *G. p. martinii* Zumpt. The author records three forms from French Equatorial Africa; these are *palpalis* in the west, *fuscipes* Newst. in the inland north and one in the Brazzaville region that he considers to be identical with *quanzensis* and with Vanderplank's Leopoldville intermediates. The distinguishing characters of the male genitalia of all three are described, and also the characters distinguishing the female genitalia of *palpalis* from those of the other two. The distribution of the three in French Equatorial Africa is discussed in some detail. They sometimes overlap, largely because the males disperse more widely than the females.

The available evidence suggests that hybridisation occurs between *fuscipes* and *quanzensis*, but not between either and *palpalis*. Females of *quanzensis* taken in an area in which they occur with males of *palpalis* yielded only *quanzensis* offspring, no larvae were obtained in an attempt to cross *palpalis* males with *quanzensis* females in 1948, and offspring obtained from the reciprocal cross did not reach the adult stage. Intermediates were found between *fuscipes* and *quanzensis* to the north of Brazzaville, but no intermediates were ever found in the district where *fuscipes* and *palpalis*

overlap. The author therefore prefers to accord specific status to *fuscipes* and to regard *quanzensis* as a subspecies of it.

The rates of infection of the salivary glands with *Trypanosoma gambiense* were 0·8 per cent. in *quanzensis* in the immediate neighbourhood of Brazzaville in January–November 1948, 0·34 per cent. in *fuscipes* in Bimbo district to the south of Bangui in October 1950 and 0·26 per cent. in *palpalis* in the district of Boko Songo in the Moyen-Congo in October 1951. There is no conclusive evidence that one is inherently better able than another to effect transmission. The most active endemic foci of sleeping sickness include the Congo basin above Brazzaville, which has *fuscipes*, *quanzensis* and intermediates, the Haute Sangha (Nola Region) with *fuscipes* and a few *palpalis*, the region of the Niari with *palpalis*, and the region of the Logone with *fuscipes* and *G. tachinoides* Westw.

Clari (L.). **Prove di demuscazione delle stalle con l'Emmaton 50.** [Tests of Emmaton 50 against Flies in Animal Quarters.]—*Ann. Sper. agr.* (N.S.) **8** no. 5 suppl. pp. lv–lxii. Rome, 1954. (With a Summary in English.)

In view of the development of resistance to chlorinated-hydrocarbon insecticides in house-flies [*Musca domestica* L.] in Italy, new products are being developed for their control. One of these is Emmaton 50, a proprietary emulsion concentrate containing 50 per cent. malathion. To prepare it, malathion dissolved in miscible oil is adsorbed on a fine suspension of a dispersed absorbent powder, which improves the lasting effect of deposits of the insecticide, and a small amount of molasses and substances attractive to the flies are added. A preliminary test in which the walls of a room were sprayed with 2 per cent. Emmaton 50 showed that the deposit was very effective against flies, but a disagreeable odour of mercaptan persisted for several days. This renders the material unsuitable for use in premises in which milk is handled, owing to the risk of tainting.

A further test was carried out in July 1953 in a building covering an area of some 2,000 sq. ft. in which pigs were housed. The animals were driven out before treatment, all food was covered with sacking, and the troughs were temporarily filled with straw. The internal walls and the walls, floor and ceiling of the building were then sprayed with 1·5 per cent. Emmaton 50 at a rate of just over 2 gals. liquid per 100 sq. ft. The treatment took 1½ hours to apply and at the end of it the floor was covered with dead flies and very few were still able to fly. Subsequent observations were carried out each morning and evening, and these showed that the deposit gave excellent mortality of flies for ten days and useful control for a further five, after which its effectiveness diminished. The odour persisted for five days. Some control was still being given after nearly 20 days, and an attempt was then made to reactivate the deposit by spraying it with water. This was unsuccessful. It is considered from these results that spraying with 2–2·5 per cent. Emmaton 50 would give control for 20 days.

Papers noticed by Title only.

Mattingly (P. F.) & Adam (J. P.). **A new Species of Cave-dwelling Anopheline** [*Anopheles rageaui*] **from the French Cameroons.**—*Ann. trop. Med. Parasit.* **48** no. 1 pp. 55–57, 1 fig., 9 refs. Liverpool, 1954.

Hoogstraal (H.). **A preliminary, annotated List of Ticks (Ixodoidea) of the Anglo-Egyptian Sudan.**—*J. Parasit.* **40** no. 3 pp. 304–310, 1 map, 5 refs. Lancaster, Pa., 1954.

Özsan (K.) & Akyay (N.). **La fièvre récurrente en Turquie. Présence dans le sud (frontière turco-syrienne) d'*Ornithodorus erraticus* infecté d'un spirochète du groupe crocidure.**—*Turk. Bull. Hyg. exp. Biol.* **14** no. 3 pp. 37–39, 6 refs. Ankara, 1954. (Also in Turkish, pp. 34–36, 5 refs.)

Epidemics of relapsing fever transmitted by lice [*Pediculus humanus humanus* L.] occurred in Turkey during periods of war and in 1947, but sporadic cases, presumably of a tick-borne form of the disease, have been observed at other times in various parts of the country, particularly in the east and south-east. There were 34 cases in the district of Urfa on the Syrian frontier in November–December 1949, and the authors began a search for ticks of the genus *Ornithodoros* there in June 1953. They could not find any in houses or animal quarters in the villages, but collected a number of small ones from the burrows of rodents. Some of these ticks were identified and proved to be the small form of *O. erraticus* (Lucas) and spirochaetes of the group of *Spirochaeta crocidurae* were isolated from one of five batches that were fed on new-born rabbits [*cf. R.A.E.*, B **41** 193].

Roadhouse (L. A. O.). **Laboratory Studies on Insect Repellency.**—*Canad. J. Zool.* **31** no. 5 pp. 535–546, 6 refs. Ottawa, 1953.

During 1942–47, more than 4,000 compounds had been tested on the human skin as repellents against mosquitos at the Orlando Laboratory, Florida, and each had been accorded one of four ratings of effectiveness [*cf. R.A.E.*, B **42** 184]. The present author classified these compounds into typical chemical groups (monoalcohols, ethers, ketones, etc.) and then calculated an average rating of effectiveness for each group from the ratings of its members. Special attention was devoted to groups containing more than 100 compounds, and appraisal of the class averages obtained indicated that the presence and arrangement of particular groups of atoms were associated with repellency. The most promising class averages were found to be of compounds that have the highest combined fat and water solubility, and that may associate in the liquid phase with themselves or with water so as to maintain a repellent concentration in the vapour phase for the longest time. On the basis of this information, further substances were prepared and, as promising ones were discovered, the molecular patterns were altered with the object of improving their effectiveness.

The tests were made by exposing the forearm in a cage containing 1,000 adults (both sexes) of *Aëdes aegypti* (L.). No cage was used unless the biting rate on the untreated forearm exceeded 40 per minute. The forearm was then covered with 1 gm. repellent and inserted into the cage for three minutes. This was repeated at half-hourly intervals. The times to first, second and third bites were recorded, together with the number of mosquitos landing in each three-minute period.

The results are given in six tables in which some 140 compounds and mixtures are grouped as monoalcohols, α-hydroxy acid esters, 1,3-diols, various polyalcohols, aldehydes and ketones, and miscellaneous compounds, derivatives being included in the first four groups. The boiling points of most of the compounds are also given.

The most effective compounds of the first group, with (in brackets) the times to first bite in minutes, were cinnamyl alcohol (270) and 2-phenylcyclohexanol (180). The latter compound is in use as a repellent and had been more effective than the former in the Orlando tests. However, the results in both laboratories for other compounds, such as geraniol, were essentially the same. There was a large difference in repellency between cinnamyl alcohol and cinnamyl acetate (136), but not between geraniol

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(80) and geraniol acetate (90). Tests of various fractions of Ceylon citronella oil showed that its repellency (90) was largely due to citronellol (120) and not to geraniol, which comprised a large portion of the oil.

The most effective compounds of the second group were benzyl lactate (360) and ethyl mandelate (300), and all the more effective compounds had boiling points of 230–260°C. Such compounds would be expected to give a vapour pressure likely to stimulate the insect's olfactory apparatus. Many of the effective compounds contained groups that should be strongly associative at the temperature of the body. The importance of structural differences in compounds of virtually identical boiling points is illustrated by the difference in effectiveness of ethyl mandelate and the structurally isomeric ethyl phenoxyacetate (60).

The most effective compounds in the third group were 2,4,4-trimethyl-1,3-dihydroxypentane (330) and 4-phenyl-1,3-dioxane (270), whereas 2,4,4-trimethyl-1,3-diacetoxypentane (30) and 1-phenyl-1,3-propanediol (45), of which the dioxane is the formal derivative, were relatively inactive. The *meso* isomer of 1,3-cyclohexanediol, a solid with a high melting point, was entirely inactive, but its diesters, which are liquid, showed activity that reached a maximum at the dipropionate (180) and di-isobutyrate (210), which would have boiling points of about 265°C.

Of compounds of the fourth group, with which 2-ethylhexanediol-1,3 (180) is listed, the only one highly effective when used alone was 1-methyl-1-phenylpropanediol-1,2 (330). Despite its similar boiling point (approximately 260°), 2-methyl-1-phenylpropanediol-1,2 was ineffective (0) alone or in groundnut oil, but a 3:1 mixture of this diol with ethyl mandelate and a 1:1 mixture with piperonal were both highly effective (360). Piperonal, which belongs to the fifth group, had much lower ratings (130–180) when used in solution in methanol or glycerol. The best compound in this group was 1-hydroxy-1-phenylpropanone-2 (360). The most effective compound of all was N,N-dicyclohexylimidazolidine (480); it was the only effective one of the miscellaneous group, and its activity was unexpected as its boiling point is high.

It is concluded from the results as a whole that, if compounds containing nitrogen are excluded, the important atom from the standpoint of repellency is oxygen. However, an oxygenated linkage such as hydroxy or carbonyl alone does not induce unusual repellency (though dimethyl phthalate is an exception to this rule). Increased repellency seems to result when a hydroxyl group is once removed from unsaturation (*i.e.*, X=C–COH, where X may be carbon or oxygen). The odour conferred by this grouping of atoms may not in itself be repellent, but may increase olfactory sensitivity so that the objectionable group is more easily perceived. It is suggested that the phenyl group is repellent. The most repellent compounds had atmospheric boiling points ranging from 230 to 260°C., and mixtures could be more repellent than their individual ingredients.

Baltazard (M.), Bahmanyar (M.), Pournaki (R.) & Mofidi (C.). *Ornithodorus tartakovskyi* **Olenev 1931 et** *Borrelia* (*Spirochacta*) *latychevi* **Sofiev 1941. Note préliminaire.**—*Ann. Parasit. hum. comp.* **27** no. 1–3 pp. 311–328, 7 figs., 8 refs. Paris, 1952.

Several strains of *Spirochacta* (*Borrelia*) *latyschewi* were isolated from batches of *Ornithodoros tartakovskyi* Olenev taken from rodent burrows in the river valley near Meshed, north-western Persia, and since neither the tick nor this spirochaete, of which it is the natural vector, was previously known outside the Soviet Union [*cf. R.A.E.*, B **31** 58–59], observations on them were made in the laboratory.

The adults of both sexes of *O. tartakovskyi* are described. The burrows from which it was taken were those of *Meriones libycus*, *Ochotona rufescens* and *Cricetulus migratorius*, but some of them were used by other animals, notably tortoises, lizards and toads. It was readily reared at a temperature of 29°C. [84·2°F.] in a saturated atmosphere in the dark, conditions that suit many other species of *Ornithodoros*, and its life-cycle did not differ from that of other small species of the genus, its development from egg to adult being completed in less than three months.

Strains of the spirochaete were isolated from seven of the 56 batches of the tick collected. These comprised 8–21 individuals each, and three of them came from burrows of *Meriones* and four from burrows that had been abandoned. Lots of 7–15 ticks from four infected batches were fed individually three times at monthly intervals on new-born rabbits and finally crushed and injected into them, but only a single tick in each lot proved infected. Transmission was effected by bite, the coxal fluid not being emitted until several minutes after the tick had left its host. The offspring of one naturally infected female included some infected individuals, but the percentage of hereditary transmission appeared fairly low. The infection was readily acquired from new-born rabbits and transmitted to them in all subsequent stages of development, the percentage of animals infected being high. A batch of 23 ticks infected *M. libycus* by bite, and two batches of 15 and 16 similarly infected man. Man was readily attacked by hungry examples, but the bite was of a mild nature.

S. latyschewi did not differ morphologically from the other spirochaetes of *Ornithodoros* spp. It was only weakly pathogenic to man and most laboratory animals, though it caused 70 per cent. mortality of new-born rabbits infected by tick bite or injection of infected blood. It did not infect adult guineapigs, and this distinguished it from all the other known spirochaetes of *Ornithodoros* spp., since even those that are not pathogenic cause at least inapparent infections. It caused weak or inapparent infections in new-born guineapigs, whereas the other species are very infective to them. Natural infection could not be demonstrated in wild rodents, but *Meriones libycus*, *Microtus arvalis* and *Rhombomys opimus* were readily infected by subcutaneous injection. In tests on the ability of other species of *Ornithodoros* to transmit *S. latyschewi* by bite and by injection, negative results were obtained with the large variety of *O. erraticus* (Lucas), with Persian and Moroccan strains of the small variety of this species [*cf.* **41** 193], and, in preliminary experiments, with *O. normandi* Larrousse. Experiments with *O. tholozani* (Lab. & Mégn.), *O. moubata* (Murr.) and North American species of the genus were still in progress, but only *O. tartakovskyi* appeared able to preserve and transmit the spirochaete.

Burgdorfer (W.) & Davis (G. E.). **Experimental Infection of the African Relapsing Fever Tick,** *Ornithodoros moubata* **(Murray), with** *Borrelia latychevi* **(Sofiev).**—*J. Parasit.* **40** no. 4 pp. 456–460, 4 refs. Lancaster, Pa., 1954.

A strain of *Spirochaeta* (*Borrelia*) *latyschewi* was obtained from infected examples of *Ornithodoros tartakovskyi* Olenev sent to the author by Baltazard [*cf.* preceding abstract]. These ticks were fed on a white mouse, and other mice were infected by inoculation of its blood as soon as it was found to contain spirochaetes. Large numbers of second- and fourth-stage nymphs and adults of *O. moubata* (Murr.) were fed on mice thus infected and were then kept at room temperature and a relative humidity of 79 per cent. A few were dissected each day and their organs were examined for spirochaetes, and haemolymph and coxal fluid from others were also

examined. The haemolymph was obtained by amputating the distal portion of the legs, and the coxal fluid by applying a warm needle or forceps to the ventral surface of the ticks, which causes them to expel it. The examinations showed that the spirochaetes persisted and multiplied in each of the stages studied. They were found consistently in the central ganglion, coxal organs and salivary glands, in the walls (but not the lumen) of the Malpighian tubes, and in the tissues of the genital system of female adults. They were also found in eggs and nymphs produced by infected females. They were often, but not always, found in the haemolymph of ticks of which the organs were infected.

The occurrence of the spirochaetes in the salivary glands and coxal organs suggested that they might be transmitted by *O. moubata*, and several hundred ticks, almost all of which showed spirochaetes in the coxal fluid, were accordingly fed on white mice or new-born rabbits. There were 73 experiments, each with a batch of 3–10 ticks, but none of the animals became infected. Further experiments indicated that these negative results were due to a loss of virulence of the spirochaetes in *O. moubata* rather than to its failure to transmit them, since infection was produced in all mice and new-born rabbits that were inoculated with blood from a mouse infected by *O. tartakovskyi* and in only a small minority of those that were inoculated with suspensions of infected examples of *O. moubata*.

Philip (C. B.), Gill (G. D.) & Geary (J. M.). **Notes on the Rabbit Tick, *Haemaphysalis leporis-palustris* (Packard), and Tularemia in central Alaska.**—*J. Parasit.* **40** no. 4 pp. 484–485. Lancaster, Pa., 1954.

Notes are given on the distribution of *Haemaphysalis leporis-palustris* (Pack.) on hares in central Alaska, based on its collection in 1937, when *Bacterium tularense* was isolated from three samples of it [*R.A.E.*, B **26** 160], and 1950–53. Further attempts to isolate this bacterium, by inoculation of suspensions into guineapigs, were unsuccessful with ticks collected from 47 hares in 1950–52, but successful with three of 14 lots collected in 1953. Aliquot portions of about half of the suspensions of the ticks collected in 1953 were injected into baby mice to test for the presence of the virus of Colorado tick fever, but the results were negative.

As it was suspected that *H. leporis-palustris* might be carrying rickettsiae of the mild type of Rocky Mountain spotted fever known to occur in it in other parts of North America [*cf.* **40** 155, etc.], two lots of the ticks that had been collected from hares and treated with antibiotics to suppress contaminants were injected directly into and passaged in embryonated eggs. Rickettsiae were observed in stained smears of the yolk sacs. The egg-propagated rickettsial isolates were avirulent in guineapigs, caused no scrotal involvement, and could not be maintained in serial passage, but seven guineapigs inoculated with them showed complete immunity on challenge with a fully virulent laboratory strain of Rocky Mountain spotted fever, and their original infection and recovery was confirmed by positive complement fixation in sera from three of them before challenge.

The collections recorded have extended the known range of *H. leporis-palustris* in central Alaska, and it is possible that *B. tularense* is more widely distributed there than available data indicate. Eight cases of tularaemia in man have been confirmed there, but the chief source of infection is the handling of hares or other infected animals, as there are no ticks that attack man in central Alaska.

Zeledón (R.). **Tripanosomiasis rangeli.**—*Rev. Biol. trop.* **2** fasc. 2 pp. 231–268, 2 figs., 63 refs. San José, Costa Rica, 1954. (With a Summary in English.)

The literature on *Trypanosoma rangeli* is reviewed in detail. It was described from the gut of *Rhodnius prolixus* Stål in Venezuela [*R.A.E.*, B **8** 183] and subsequently found in man there [**35** 123] and in Colombia and Guatemala. Since a trypanosome obtained from a species of *Cebus* in French Guiana by Floch & Abonnenc appears to be identical with it, its natural vertebrate host is probably a monkey. Records of its occurrence in Triatomines in Chile and in man in Argentina are considered unreliable. *T. ariarii*, which was recorded by Groot from man and *R. prolixus* in Colombia [**42** 87], was subsequently considered identical with *T. rangeli* by him, a view with which the author concurs. *T. rangeli* is distinct from *T. lewisi*, which does not develop in the intestine of *R. prolixus*, but if *T. escomeli* [**8** 97] is not identical with *T.* (*Schizotrypanum*) *cruzi*, this may be an earlier name for it. *T. rangeli* appears to be non-pathogenic to man, and human cases are characterised by the persistence and the small numbers of trypanosomes in the blood.

In experiments by the author, an *ariarii* strain of *T. rangeli* from Colombia was injected into rats and mice, but appeared to have lost its virulence. When a Venezuelan strain of *T. rangeli* was injected into the body cavity of nymphs of *R. prolixus*, the trypanosomes developed in the haemolymph in the same way and showed the same forms as in culture media. Phagocytosis occurred, but had little effect in view of the high rate of multiplication. The salivary glands of two adults into the body cavity of which a culture of *T. rangeli* had been injected a month previously showed no infection, but flagellates were found in those of adults dissected two months and 13 weeks after injection. Reproduction occurred in the glands, and re-infections of the haemolymph may result from this source. Attempts to infect laboratory rodents and dogs by injection of haemolymph from infected *R. prolixus* and cultures of *T. rangeli*, and *Cebus* adults by injection of cultures, were unsuccessful.

Wood (S. F.). **Environmental Temperature as a Factor in Development of *Trypanosoma cruzi* in *Triatoma protracta*.**—*Exp. Parasit.* **3** no. 3 pp. 227–233, 10 refs. New York, N.Y., 1954.

Previously uninfected adults of *Triatoma protracta* (Uhl.) were fed on rats infected with a Brazilian strain of *Trypanosoma cruzi* and subsequently on uninfected animals, and the faecal droplets excreted by them were examined periodically. Most tests were made under summer conditions at O'Neals, California, at temperatures of about 30°C. [86°F.], though they varied considerably, and a few at lower temperatures (about 22·5°C. [72·5°F.]). Metacyclic trypanosomes appeared in the droplets as early as seven days after an infective meal at the higher temperatures, but were not found as late as 12 days, and in one instance 56 days, at the lower temperatures.

Elliott (M.). **Allethrin.**—*J. Sci. Fd Agric.* **5** no. 11 pp. 505–514, 9 figs., 46 refs. London, 1954.

The author reviews work on the structure and synthesis of the acid and alcoholic components of the pyrethrins, which led to the preparation of the

closely related synthetic compound, allethrin (the ester of *dl-cis-trans*-chrysanthemic acid with *dl*-allethrolone) [*cf. R.A.E.*, B **38** 103, 208, etc.], and gives the results of tests to determine the relative insecticidal activity and abundance of the eight isomeric esters present in it [*cf.* **40** 116].

The relative contact toxicities to *Phaedon cochleariae* (F.) of the esters formed by *d*-allethrolone with *d-trans*-chrysanthemic acid, *dl*-allethrolone with the *d-trans* and *dl-trans* acids, and *l*-allethrolone with the *l-trans* acid were 100, 64, 22 and 0·003, respectively. The relative toxicities of the esters of *dl*-allethrolone with the *d-* and *dl-trans*, *d-* and *dl-cis*, *dl-cis-trans*, *l-cis* and *l-trans* acids were 100, 35, 21, 15, 32, 2 and 3 in tests on *P. cochleariae* and 100, 56, 63, 32, 37 and 6 for the first six in tests on *Tenebrio molitor* L. The relative toxicities of some of these esters of *dl*-allethrolone in tests against other insects (100 for the *d-trans* acid ester in each case) were 46, 48 and 85 for *dl-cis-trans* against *Plutella maculipennis* (Curt.), *Macrosiphum solanifolii* (Ashm.) (*euphorbiae*, auct.) and *Oryzaephilus surinamensis* (L.), 72, 33 and 3 for *dl-trans*, *dl-cis* and *l-trans* against *Plutella*, and 53 and 25 for *dl-trans* and *dl-cis* against *Dysdercus fasciatus* Sign.

Spectrum analysis of the allethrin used in these tests, carried out by Crombie, showed that it contained 75 per cent. of the *trans* and 25 per cent. of the *cis* acids. The discrepancy between this result and that obtained biologically [**41** 125] may be due to variations in the ratios of α and β isomers [*cf.* **40** 117] in the *dl-trans*-acid ester of *dl*-allethrolone, in the *dl-cis* ester (for which they must exist, although they have not yet been separated) and in allethrin itself, since the α and β forms have different insecticidal activities. Such a variation might be produced by different reaction conditions and varying, non-stoicheiometric ratios of the reagents used in the preparation of the esters.

The effect of various changes in the molecule of allethrin on insecticidal activity is discussed. The biological action of the compound appears to be of a similar nature to that of the natural pyrethrins, and is associated with the particular stereochemical conformation in which the various parts of the molecule are held with respect to one another and with the chemical and physical properties of the groups so positioned. No esters of chrysanthemic acid, except those with alcohols closely related to pyrethrolone, cinerolone or allethrolone, have been reported to show characteristic pyrethrin-like activity, and the only acids that give insecticidal esters of the keto-alcohols are closely related to chrysanthemic acid.

Although allethrin is inferior to the natural pyrethrins against most insects and by most methods of application, it is highly active and, unlike many modern synthetic insecticides, has, so far, been found harmless to mammals.

NASH (R.). **Studies on the synergistic Effect of Piperonyl Butoxide and Isobutylundecyleneamide on Pyrethrins and Allethrin.**—*Ann. appl. Biol.* **41** no. 4 pp. 652–663, 1 fig., 22 refs. London, 1954.

The following is virtually the author's summary. Experiments are described to compare the toxicity of natural pyrethrins and allethrin and to show the effect of piperonyl butoxide and isobutyl undecyleneamide (IN 930) as synergists with them, using a measured-drop technique with house-flies (*Musca domestica* L.) and a residual-film technique with bed-bugs (*Cimex lectularius* L.). In the conditions of the experiment, pyrethrins proved to be twice as toxic as allethrin to flies, and 5·5 times as toxic to bugs. The synergists were tested at several ratios to the insecticides, ranging from 1:1

to 20:1. The results were plotted as series of log concentration/probit mortality regression lines. These were parallel for the bug tests; but in the fly tests, the slope of the line increased with a rise in the proportion of synergist to insecticide. An increase in potency, as estimated from the median lethal concentrations of insecticide, resulted in all cases as the ratio of synergist to insecticide was increased, at least up to 20:1 [*cf. R.A.E.*, B **41** 164], but the rate of increase of potency was greater for the smaller ratios and fell off as the ratio increased. Piperonyl butoxide was the more powerful synergist, increasing the potency of pyrethrins five times and allethrin four times to flies, and pyrethrins twice and allethrin three times to bugs, whereas IN 930 did not increase the potency of either ingredient more than twice to either test insect.

The effectiveness of films of pyrethrins was greatly prolonged by the addition of piperonyl butoxide to the solutions used to form them; but an experiment designed to investigate the effect of the synergist on the stability of the insecticide showed that this action, if it exists, must be slight.

Kühl (R.). **Das Zeitproblem in der Dasselprophylaxe.** [The Problem of Timing in Warble-fly Prophylaxis.]—*Anz. Schädlingsk.* **27** pt. 1 pp. 7–8. 1 ref. Berlin, 1954.

Although infestation of cattle by warble-flies [*Hypoderma*] can be prevented if they are sprayed weekly with BHC during the fly season [*R.A.E.*, B **41** 23; **42** 44], it is necessary in practice to find a material that will give effective protection with less frequent application, and experiments were carried out in southern Germany in 1952 with sprays containing DDT or a combined preparation of lindane (almost pure γ BHC) and chlordane applied liberally at intervals of three weeks to calves and yearlings in mountain pastures. Though there were differences in the effectiveness of the two sprays in certain herds and groups of animals, the average total infestation was not significantly different from that in the controls.

Poliomyelitis in Hidalgo County, Texas, 1948.

Paffenbarger jr. (R. S.) & Watt (J.). **Epidemiologic Observations.**—*Amer. J. Hyg.* **58** no. 3 pp. 269–287, 4 figs., 14 refs. Baltimore, Md., 1953.

Melnick (J. L.) & Dow (R. P.). **Poliomyelitis and Coxsackie Viruses from Flies.**—*T.c.* pp. 288–309, 5 figs., 10 refs.

Francis jr. (T.), Brown (G. C.) & Ainslie (J. D.). **Poliomyelitis and Coxsackie Viruses in Privy Specimens.**—*T.c.* pp. 310–318, 2 figs., 10 refs.

The background of the studies that are the subject of these three papers is given in the first. Nine towns in Hidalgo County, Texas, were treated with DDT for community control of flies from March 1946 to February 1948, with a consequent reduction in diarrhoeal disease due to *Shigella* [*R.A.E.*, B **39** 86]. Just before the work was due to end, numerous cases of poliomyelitis were reported in the county, and it was therefore continued to ascertain its effect on the incidence of this disease and facilitate an epidemiological study of the relative importance of flies and direct human contact in its transmission. This study was carried out in the treated and untreated towns and rural areas of Hidalgo County and, less intensively, in the two counties adjoining it on the east. Though the untreated towns had no fly control, they had the same fly-count system as the treated ones.

Fluctuations in abundance of flies, the monthly numbers of poliomyelitis cases in the different areas, attack rates for areas and age groups and other data are given in tables and graphs and discussed in detail. The first cases were in February, a few weeks before the seasonal rise in fly numbers. A gradual increase in number of cases continued into May and was roughly parallel with an increase in fly counts. This parallel is particularly striking if the untreated towns alone are considered. If the treated towns are similarly considered, there was a rise in cases that coincided with increasing difficulties in control, indicated by higher fly counts from April to July. These town parallels could suggest that flies helped to start the epidemics or actually caused them, but there was no such parallel in the rural areas or the other counties, where the growth of the fly population was essentially similar to that in the untreated towns. The median cases of the respective areas occurred at the end of April in the untreated towns, in the second half of May in the treated ones, and early and late in June (long after the build-up in fly population) in the other two counties. There were thus some areas with poliomyelitis before fly increase, some with coincidental increase of flies and cases, and others in which poliomyelitis occurred much later than the increase of flies.

Observations relating to the question of spread by human contact are also discussed in detail. The ratio of cases with contact history to total cases was roughly 7/10 in untreated towns, 6/10 in treated towns and 5/10 in the rural area. It is concluded that community fly control before and during the outbreak failed to reduce the number of poliomyelitis cases or to affect the time-course of the epidemic in the towns in which it was practised, and that personal contact between paralytic cases and susceptible people, directly or through an intermediary, played the definitive part in the development and spread of the epidemic.

The second paper is a report of the isolation of poliomyelitis and Coxsackie viruses from flies collected during the epidemic. Evidence in support of the view that flies are of importance in the spread of these viruses [*cf. R.A.E.*, B **43** 58, etc.] and lacunae in it are very briefly reviewed, and details are given of the ways in which the flies were collected and stored, the material from pools of them was prepared and used to inoculate monkeys (for poliomyelitis) or new-born mice (for Coxsackie viruses), and the results as regards genera of flies, dates of isolation in relation to the occurrence of cases of poliomyelitis in the places in which the flies were collected and the course of the epidemic in Hidalgo County as a whole, and the characteristics of the viruses isolated.

The flies for test were collected from April to November in four towns, and cases of poliomyelitis in man occurred in three of them, including the only one in which the fly-control programme was in effect. A special device [**39** 133] was used to collect the flies after 19th April, either from baits or, exclusively after 23rd May, from natural assemblages. Most of the flies belonged to the genera *Musca* (represented solely by *M. domestica* L.), *Sarcophagula* and *Lucilia* (*Phaenicia*), and the ratios of positive to total samples of these genera in the tests for poliomyelitis virus were, respectively 6/35, 5/34 and 6/39. In the tests for Coxsackie viruses, they were 14/30, 11/29 and 12/32. Poliomyelitis virus was also isolated from a pool of flies of other genera (not tested for Coxsackie viruses), and Coxsackie viruses from some pools of unidentified flies; the total numbers of samples tested for the two viruses were 120 and 100, and the numbers positive were 18 and 45. Seven samples were positive for both. The total numbers of flies tested for the poliomyelitis and Coxsackie viruses were over 97 and 93 thousands, the smallest of the respective positive samples comprised 28 and 35 flies and the largest negative one comprised 8,094.

Poliomyelitis virus was more prevalent in the flies during the peak of the epidemic than later, the sample ratios being 16/60 in April–May, 2/26 in June and 0/34 during July–November, and positive flies were found in one area three weeks before paralytic cases occurred in the same part of the town. The three major genera all contained the virus in May in the town in which the disease was not recorded. There appeared to be a correlation between the findings of poliomyelitis virus in the flies and in privy specimens in the same areas, as recorded in the third paper, and it is suggested that a highly contaminated environment may be a source of infection of man. If so, the history of contact discussed in the first paper may not necessarily show cause and effect; it may sometimes indicate common association of the two cases with this other source of virus. The occurrence of the virus in the flies may be another index of the infected place, or perhaps at times an actual source of infection at the place.

Comment on instances of simultaneous infection of communities with poliomyelitis and Coxsackie viruses was made by Melnick & Curnen in a book already noticed [**41** 113]. In this study, they appeared to go their independent ways, with poliomyelitis virus leaving the fly population soon after the epidemic began to wane and Coxsackie viruses remaining at about the same level from April to November.

Isolations of the viruses from specimens of stools from privies in the four towns are recorded in the third paper, and the correlation between the presence or absence of poliomyelitis virus in the stools and flies is confirmed. The yields of Coxsackie viruses were also in general agreement. The isolation of poliomyelitis virus from privies in the town in which flies harboured it in the absence of recorded cases in man showed that subclinical infections occurred there.

Iyengar (M. O. T.) & Menon (M. A. U.). **Mosquitos of the Maldive Islands.**—*Bull. ent. Res.* **46** pt. 1 pp. 1–9, 6 figs., 13 refs. London, 1955. With an Appendix by P. F. Mattingly.—*T.c.* pp. 9–10, 5 refs.

Study of a large collection of mosquitos made by the authors on five atolls of the Maldive Islands revealed the presence of 15 species, including two species of *Anopheles* (*subpictus* Grassi and *tessellatus* Theo.); eight of *Culex* and three of *Aëdes* (all of the subgenus *Stegomyia*). Among them were the four species previously recorded from the Maldives. Notes of taxonomic interest on the species of *Aëdes* and five of the species of *Culex* are given, in part by the authors and in part by Mattingly in the appendix. They include *C. infantulus* Edw. of which Mattingly has found *C. parainfantulus* Menon [*R.A.E.*, B **33** 180] to be a synonym.

Glover (P. E.), Jackson (C. H. N.), Robertson (A. G.) & Thomson (W. E. F.). **The Extermination of the Tsetse Fly,** *Glossina morsitans* **Westw., at Abercorn, Northern Rhodesia.**—*Bull. ent. Res.* **46** pt. 1 pp. 57–67, 1 map, 3 refs. London, 1955.

The following is the authors' summary. European farms at Abercorn had been suffering from bovine trypanosomiasis carried by *Glossina morsitans* Westw., and the Tanganyika Department of Tsetse Research were asked in 1935 to advise. Fly-pickets were established in 1936 to prevent carriage of flies on to the farms, and a belt of country was protected from fire, with the object of thickening the woody vegetation so as to make it unfavourable to *G. morsitans*. The fire-protected area was extended and continued until 1946; serious escape fires occurred in 1938 and 1941. During

these first five years the reduction in catches at the pickets was only about one-third.

An intensive survey of the area was made in 1941, as the result of which concentrations of flies were identified in certain shallow valleys forming the headwaters of small tributary streams. Several of these were cleared of trees, with the result that the apparent density of *G. morsitans* was at once depressed not only in the valleys themselves but over wide areas of untouched woodland round about. In 1942 and the following years these clearings were extended to new valley sites as they were discovered, both inside and outside the fire-excluded area, and always with striking effects. The last clearing of all was done in 1952. From 1942 an increasing proportion of female *G. morsitans* remained virgin through failure of the sexes to meet, and by 1945, 29 per cent. of non-teneral females had not been inseminated. The proportion doubtless increased thereafter, and there can have been no breeding population of flies in the area for several years. The general effect was seen in the fly-picket catches, but during the régime of fire exclusion these showed a considerable lag when compared with fly-rounds within the fly habitat itself, because the unburned grass caused the remaining flies to concentrate on paths and firebreaks along which they were carried to the pickets.

There was slight infiltration from the Lufu fly-belt to the south-west, which greatly diminished when the nearest portions of that belt were also attacked by discriminative clearing in 1946. The Lufu flies are separated from the Abercorn belt by high country which forms a barrier across which flies are occasionally carried on men. There was also slight infiltration of flies from Tanganyika Territory to the north, which was separated from the Abercorn belt only by a buffer zone of discriminative clearings to a depth of 16 miles. Cattle, however, can now be kept in the Abercorn area with negligible danger of trypanosomiasis.

Fire exclusion alone was not a quick means of reducing fly numbers. Discriminative clearing, with or without fire exclusion, was very effective and cheap. How it worked we still do not know. The total area of the discriminative clearings was less than 3 per cent. of the whole experimental area of 280 sq. miles.

Mattingly (P. F.) & Brown (E. S.). **The Mosquitos (Diptera: Culicidae) of the Seychelles.**—*Bull. ent. Res.* **46** pt. 1 pp. 69–110, 3 pls., 11 figs., 110 refs. London, 1955.

This paper is in separate sections of which those on taxonomy and zoogeography and the two appendices are by Mattingly and the section on bionomics and local distribution is by Brown. The following is mainly based on the authors' summary. Previous records of mosquitos from the Seychelles are reviewed, and a list is given of those known to occur there, which belong to four genera of Culicini. New records are included, based on collections recently made by Brown. Some notes are given regarding the taxonomy, bionomics and local distribution of the species concerned and the zoogeography of the groups to which they belong; the section on taxonomy includes descriptions of one new species and one new subspecies, and the first full descriptions of the male terminalia and pupae of two other species. The appendices comprise a review of records of mosquitos from other islands in the western Indian Ocean and corrections to the key to larvae of *Culex* given in a recent work by Hopkins [*R.A.E.*, B **40** 105].

NASH (T. A. M.). **A Note on the Parasitisation of the Oöthecae of *Periplaneta americana* (L.) by the Chalcid, *Syntomosphyrum glossinae* Wtstn.**—*Bull. ent. Res.* **46** pt. 1 pp. 111–112, 3 refs. London, 1955.

When it was discovered that *Syntomosphyrum glossinae* Wtstn. occurred as a pupal parasite of *Glossina palpalis* (R.-D.) in northern Nigeria [*R.A.E.*, B **36** 70], strict measures were taken to prevent its access to the fly-breeding establishment of the West African Institute for Trypanosomiasis Research, where thousands of pupae of *G. palpalis* are bred monthly. The pupae are all kept under a half-inch layer of sand in containers covered with organdie, a material fine enough to exclude even this small parasite. The sand is an additional protection, as the parasite cannot penetrate it to a depth of more than 0·1 inch [*cf.* **21** 198].

In November 1953, adults of the parasite appeared in numbers on the inside of the windows of the fly-room, although it was not present in the rearing boxes, and investigation showed that it had parasitised and was emerging from oöthecae of *Periplaneta americana* (L.) on the floor. About 40 oöthecae parasitised by it were found. Control measures against cockroaches were immediately put into force, and the parasite was not seen again in the rearing room during the next three months; its failure to reach the tsetse pupae demonstrated the effectiveness of the method employed to protect them.

The possibility of using this Eulophid for the control of cockroach infestations in buildings is suggested.

CAMERON (E.). **On the Parasites and Predators of the Cockroach. I. *Tetrastichus hagenowii* (Ratz.).**—*Bull. ent. Res.* **46** pt. 1 pp. 137–147, 3 figs., 50 refs. London, 1955.

The first part of this paper is an introduction to a proposed series on the natural enemies of cockroaches and opens with a very brief note on the medical importance of the species that are pests in houses, the difficulty of controlling them, and the possibility that biological control might be a valuable auxiliary to the use of insecticides. The variety of organisms associated with cockroaches is then pointed out, and two lists of them are given. The first comprises 24 insect parasites and 12 arthropod predators and shows the cockroaches attacked by the various species, the countries concerned and the authorities for the records. The second comprises other parasites and symbionts; most of them are protozoa or nematodes, but they include a few bacteria and one alga. The individual host records are not given.

The second part is devoted to a study of *Tetrastichus hagenowii* (Ratz.), which is a widely distributed parasite of the eggs of *Blatta orientalis* L., *Blattella germanica* (L.), *Periplaneta americana* (L.) and *P. australasiae* (F.), the principal household cockroaches, but has not been found in Britain. The immature stages of this Eulophid and some characters of the adults are described, and an account is given of experiments in which it was reared in the laboratory in England. It was obtained for rearing from oöthecae of the two species of *Periplaneta* from Trinidad and Saudi Arabia and was invariably a primary parasite of the eggs of these cockroaches. Lever's record of its being a hyperparasite, on *Evania* [*R.A.E.*, B **36** 139; *cf.* also **3** 126], is believed to be based on an instance of purely accidental competition. The numbers of adults that emerged from single oöthecae of *P. australasiae* and *P. americana* were usually 40–50 and 30–40, but over 100 occasionally emerged from oöthecae of *P. australasiae*. The average ratio of females to males in an oötheca was 4:1. As many as 48 young larvae of *T. hagenowii*

were recovered from a single cockroach egg. The larvae fed for a considerable time on the contents of the egg in which they hatched and then devoured unparasitised eggs until, when they had reached maturity, the entire contents of the oötheca had disappeared. The life-cycle from egg to adult lasted over three months at 60–65°F., but there are several generations in a year in hot climates [**26** 21].

LUMSDEN (W. H. R.). **Entomological Studies, relating to Yellow Fever Epidemiology, at Gede and Taveta, Kenya.**—*Bull. ent. Res.* **46** pt. 1 pp. 149–183, 6 figs., 48 refs. London, 1955.

The following is partly based on the author's summary. The theoretical objections to the explanation of the persistence of yellow-fever virus in areas subject to a prolonged dry season by cycles involving only mosquitos and wild primates [*R.A.E.*, B **41** 93, 147, etc.] are discussed in relation to the results of field surveys in 1951 in areas of this type in Kenya. The localities studied were Gede, on the coast about 65 miles north of Mombasa [*cf.* **39** 20], which was visited towards the end of the dry season, and Taveta, near Mount Kilimanjaro, visited during the main wet season for comparative purposes. The topography, climate, vegetation and population of the areas are briefly described. The work included 24-hour mosquito catches with human bait at ground level and in the canopy foliage, moving catches by teams of 4–9 and larval collections from all the main typical environments. All the species of biting arthropod taken at each locality are recorded; in each case most were mosquitos. The catches are discussed.

At Gede, where immunity from yellow fever has been demonstrated in wild primates, the only mosquitos that were abundant as biting adults were *Aëdes fryeri* (Theo.) and *A. pembaensis* (Theo.), which breed in sea water, and they were practically confined to the close neighbourhood of their breeding places. Their vertical distributions and biting-cycles are defined. *A. africanus* (Theo.) and *A. simpsoni* (Theo.) were not found. Mosquito larvae were readily obtained by filling tree holes with water, but no naturally water-filled tree holes or leaf axils were found in intensive searches in all the natural environments in the area. Attempts to demonstrate the presence of adult mosquitos of the small-container breeding habit in natural environments during the dry season by means of oviposition pots are reported for Gede and are compared with the findings at Taveta. Possible fallacies of such work and precautions necessary in it are discussed. Larvae of *A. aegypti* (L.) were found in domestic containers, but the high level of artificially-induced immunity in man in the area makes the persistence of virus by the *aegypti*-man cycle very unlikely.

A. simpsoni, a field vector of yellow-fever virus to man in Uganda [**31** 61], was found in abundance biting man at Taveta during daylight, but few if any naturally immune people and no immune monkeys were discovered there. *A. africanus*, a vector of yellow-fever virus among monkeys in Uganda [**39** 132; **40** 51], was also found at Taveta, but its behaviour differed considerably from what is regarded as characteristic of it in Uganda [**35** 68] and West Africa [**37** 177]. It bit only in very small numbers and almost as much at ground level as in the canopy. All biting females except one were taken during daylight and there were morning and evening periods of activity. This suggests that at Taveta it may attack mainly some animal other than monkeys.

It is thought that yellow-fever infection has existed for some time in wild mammals on the Kenya coast, but the absence of epidemics there or at Asiatic ports indicates that its introduction into man has been very rare,

as has also been its occurrence in monkeys. The rarity of immunity in man and monkeys and its prevalence among bush-babies (*Galago*) [*cf.* **39** 20; **42** 86] indicate that the cycle in bush-babies is probably entirely separate. It appears that the transfer of virus from the bush-baby cycle to the complex involving man, monkeys, *A. africanus* and *A. simpsoni* would be followed by widespread transmission in these.

It has not yet been shown that mosquitos that breed in small containers, as vectors of yellow-fever virus generally do, are ever present as adults in more than very small numbers after a prolonged drought [**40** 79; **41** 167–168]. The maintenance of virus in such conditions by cycles involving only these mosquitos and wild mammals would therefore appear to be very precarious.

McArthur (J.). **The Control of Malaria in Borneo. (An Account of the Tambunan Experiment.)**—*Trans. R. Soc. trop. Med. Hyg.* **48** no. 3 pp. 234–241, 1 fig., 8 refs. London, 1954.

Investigations have shown that the chief, and generally the only, vector of malaria throughout the greater part of Borneo is *Anopheles leucosphyrus* Dön. [*R.A.E.*, B **36** 203], and D. H. Colless has informed the author that both the typical form and *A. leucosphyrus* var. *balabacensis* Baisas are concerned in transmission there [*cf.* **37** 145; **42** 145]. It has also been shown that small-scale clearing to admit sunlight to the seepages in which breeding takes place under jungle shade [**38** 169] causes the immediate disappearance of the mosquito. In view of this, an experiment was made in Tambunan, in the interior of North Borneo, in 1949–52 to determine whether clearing jungle over seepages would also cause the disappearance of malaria. The experimental area, of about ten square miles, was a valley with irrigated rice-fields and five intensely malarious villages surrounded by jungle-covered hills in which *A. l. balabacensis* bred widely. It was very inaccessible. Spleen rates in children aged 2–10 years had consistently averaged over 80 per cent. at every examination during the previous 14 years.

Jungle was cleared over all seepages (about 200, involving about 32 miles of waterways) to admit morning sun. The clearing, which involved mainly small dense secondary scrub and little big timber, did not alter the appearance of the landscape or encourage erosion. It was carried out in 1949, by about 50 men working for three months, and there was an immediate reduction of 95 per cent. in breeding of *A. l. balabacensis*, which was maintained throughout the next three years without significant further work. Spleen rates in children fell from 86 per cent. in 1949 to 56, 53 and 45 per per cent. in 1950–52. Some transmission continued, possibly by infected mosquitos filtering in from surrounding uncontrolled highly malarious villages. The spleen rate in a valley selected to serve as a control, which had been 100 per cent. at every examination since 1939, remained at this level in 1949, 1950 and 1951, while conditions were unaltered, but fell to 75 per cent. in 1952. This fall was found to be due to the initiative of a new headman who had been appointed in 1951 and had distributed drugs to children and imitated the measures carried out in the experimental area.

An experiment on the scale of an actual campaign to eliminate infiltration of infected mosquitos and test other means of clearing, such as the use of selective herbicides, is advocated. It is believed that the experiment has shown the method to be effective, relatively permanent and suitable for use by the people themselves.

Smith (A.). **The Distribution and Host Choice of resting *A. gambiae* Giles and *A. funestus* Giles in Cone Huts on Ukara Island, Tanganyika.**—*E. Afr. med. J.* **32** no. 1 pp. 7–13, 1 ref. Nairobi, 1955.

Anopheles gambiae Giles and *A. funestus* Giles are important vectors of *Wuchereria bancrofti* on Ukara Island. An account is given of studies of their pattern of resting during the long rains (March–May) and the long dry season (June–October) in huts of the traditional cone shape that is the commonest among the 5,000 huts on the island. These huts are made of a framework of branches, thatched from top to bottom, and average 21 ft. in height and 23 ft. in diameter at the base. The average numbers of occupants per hut were 3·3 people, 2·8 cattle and 1·6 goats. The hut is divided into two sections by a partition about 6 ft. high, extending across two-thirds of its breadth from one side of the doorway. The door leads into the section in which the animals are kept and the people live in the other section, which is darker and more sheltered because it is more completely thatched. Of the females of the two mosquitos taken in the huts, the percentages resting in the dwelling section, and within seven feet of the ground in both sections, were 63 and 80 for *A. gambiae* and 67 and 79 for *A. funestus* in April, and 67 and 64 for *A. gambiae* and 75 and 72 for *A. funestus* in July. Precipitin tests on blood-fed females from the huts showed that the percentages that had fed on man and (in brackets) cattle were 98 (2) for *A. gambiae* in April and 86 (13) for *A. gambiae* and 92 (8) for *A. funestus* in July. In July, but not April, a few females positive for ox blood were found in the dwelling sections of the huts, and there was some multiple feeding on man and ox in July but none in April. The change in resting position in the dry season may be caused by the mosquitos' seeking shelter from the strong winds that blow then. These may also cause the change in feeding habits by mixing scents and making host distinction difficult.

Harley (J. M. B.). **The Breeding Sites of the Tsetse Fly *Glossina morsitans*.**—*Acta trop.* **11** no. 4 pp. 379–402, 20 figs., 4 refs. Basle, 1954. (With Summaries in French and German.)

Two belts of *Glossina morsitans* Westw. cover much of the north-central and western areas of Tanganyika, but the flies of the central belt are distinguishable from those of the great western belt by being generally paler in colour [*R.A.E.*, B **40** 123]. The sites in which the pupae of the two races occur in the cool, hot, and rainy seasons (June–July, October and April, respectively) were compared during 1951–53 to discover whether they differ and whether there is a seasonal shift in breeding grounds similar to that recorded in Nigeria [**27** 261]. The observations were made in the Singida district of the central fly-belt and the Kahama district of the western one, and the vegetation of each area is described. Both were in the typical *Brachystegia-Pseudoberlinia* woodland habitat of this fly in tropical Africa, which in both was broken up by grassy valleys, but there was less undergrowth and more grass at Singida, the valleys there were narrower and more numerous, and the grass in them was shorter. The woodland soil in both comprised a surface layer, about an inch deep, of loose, coarse sand, over a more compacted layer, mainly of sand, and the soil in the grassy valleys was chiefly fine clay. Virtually all the pupae found were buried in the soil, mostly at a depth of ½ inch, and none was in hard soil.

In both areas, pupae occurred in the woodland during all seasons, most of them under logs. At Singida, the sites utilised during the hot season,

when the woodland trees were leafless, were the shadiest and coolest available, and the pupae were then under larger logs than at other times. They were also found at this season under leaning trees, in rot-holes in trees, under trees and in thickets that gave good shade in the valleys and, in smaller numbers, in tree stumps, in the burrows of ant-bears (*Orycteropus afer*), and under rocks. They were most numerous under logs during the cool season, when tree stumps and cavities below the enlarged bases of trees were also occasionally used, and least during the rains, when the concentrations beneath individual logs were also small. During the hot season most pupae were found in the valleys, where the grass was burnt. At Kahama, pupae were rather less numerous. The numbers under logs showed little seasonal variation, but were actually slightly greater during the rains, possibly because rainfall was abnormally low. There was a tendency to use logs giving slightly more shade during the hot season, when a few pupae were also found near the base of the petioles on young palm trees, under the fallen fronds below the old ones, under leaning trees, and in rot-holes; palm trees and leaning trees were also used to some extent during the cool season. No pupae were found in the valleys, where the grass remained long throughout the period concerned. At both places, log sites were virtually the only ones used during the rains.

Observations on the soil temperatures at sites with pupae were made during all seasons. In both areas, soil temperatures differed by an average of about 4°C. [7·2°F.], although larvipositing females evidently attempted to select the coolest sites available in the hot season and the warmest shady ones during the cool season. At Singida, the average temperature under 11 small logs was 21·5°C. [70·7°F.] in June, when 99 pupae were found there, and 29°C. [84·2°F.] in October, when there was none; under three large ones that were not used in June but where five pupae were found in October, the average temperature in the latter month was 26°C. [78·8°F.]. The presence of pupae was not correlated with atmospheric humidity or with light. Despite thorough search, the number of pupae found represented only a small proportion of the number that must have been present to maintain the adult population at its existing level.

Vogelsang (E. G.). *Heterodoxus spiniger* (**Enderlein**), **malófago parásito del canino** (*Canis fam.*) **de Venezuela.** [*H. spiniger*, a Mallophagan Parasite of the Dog (*Canis familiaris*) in Venezuela.]—*Bol. Ent. venezol.* **9** no. 1–4 pp. 55–56, 4 refs. Maracay, 1954.

A record of *Heterodoxus longitarsus* (Piag.) on dogs in Venezuela is corrected as a result of consultation with Werneck. The species was in fact *H. spiniger* (End.). The two differ only in characters of the male genitalia, and it is probable that all records of *H. longitarsus* on dogs [*cf. R.A.E.*, B **19** 23; **21** 255; **24** 232; **26** 149; **29** 30; **33** 23; **35** 8] refer to *H. spiniger*.

Bell (R. R.), Price (M. A.) & Turk (R. D.). **Toxicity of Malathon and Chlorthion to Dogs and Cats.**—*J. Amer. vet. med. Ass.* **126** no. 937 pp. 302–303, 2 refs. Chicago, Ill., 1955.

The experiments described were undertaken to determine whether the new phosphorus insecticides, which have shown promise for the control of ectoparasites of animals in preliminary trials, could be applied at effective strengths without danger to the host. Malathion and chlorthion (O,O-dimethyl O-3-chloro-4-nitrophenyl thiophosphate) were used. According to

the manufacturer's bulletin, the acute oral median lethal dose for rats of 99 per cent. malathion in maize oil was 1,845 mg. per kg. body weight, intravenous injection of 100 mg. per kg. into dogs had no apparent effect but 200 mg. caused death, and the minimum lethal dose (using 90 per cent. technical material) as a single application to the skin of rabbits, which was washed off after 18 hours, was more than 6,150 mg. and less than 12,300 mg. per kg. In the only other investigation of which record was available, the median lethal oral dose of both malathion and chlorthion for rats was given as 1,500 mg. per kg., subacute toxicity studies indicated that daily intraperitoneal doses of 100 mg. per kg. had to continue for about 60 days to produce 50 per cent. mortality, and 50 mg. per kg. similarly administered caused no deaths.

In the authors' experiments, 16 dogs were treated with malathion and none of them showed any ill effects. They comprised ten that received 500–3,500 mg. per kg. by mouth (using 95 per cent. technical material), all of which vomited within 35 minutes, two that received 3,500 mg. per kg. through a stomach tube and were then anaesthetised for 12 hours to prevent vomiting, and four that were dipped four times at intervals of four days in 2 per cent. emulsified solution. Chlorthion was tested in dips prepared from an emulsifiable solution to give concentrations of 2, 1, 0·5 and 0·25 per cent., and the animals were dipped up to four times at intervals of four days. Four dogs showed no apparent signs of poisoning after one dipping in 2 per cent. chlorthion, but all died within 36 hours of the second dipping. Of four dogs dipped in 1 per cent., one died after the second dipping, two after the third and one after the fourth. Of five dipped in 0·5 per cent., one died after the first dipping and two after the third. Two survived the four dippings, but lost weight and appetite and showed a slow heart rate, depression and excessive salivation. They vomited frequently after the fourth dipping. Four dogs and four cats dipped four times in 0·25 per cent. chlorthion showed no signs of poisoning. No lesions that could be attributed to the insecticides used were found at autopsy in any of the animals; those that survived the treatments were killed for examination three weeks later.

Papers noticed by Title only.

Eklund (C. M.). **Parasitological Reviews. Mosquito-transmitted Encephalitis Viruses. A Review of their Insect and Vertebrate Hosts and the Mechanisms for Survival and Dispersion.**—*Exp. Parasit.* **3** no. 3 pp. 285–305, 5 pp. refs. New York, N. Y., 1954.

Laird (M.). **Abnormalities exhibited by Mosquito Larvae** [*Culex annulirostris* Skuse] **collected in Tonga.**—*Bull. ent. Res.* **46** pt. 1 pp. 185–188, 2 figs., 3 refs. London, 1955.

Mohan Babu Naidu. **Physiological Action of Drugs and Insecticides on Insects** [studied on isolated cockroach heart].—*Bull. ent. Res.* **46** pt. 1 pp. 205–220, 8 figs., 31 refs. London, 1955. [See *R.A.E.*, A **42** 169.]

Cvetanović (R. J.) & Pielou (D. P.). **Preparation of standard Films of crystalline p-p′-DDT for Laboratory Investigation by Sublimation.**—*Canad. J. Tech.* **32** pp. 174–178, 3 figs., 15 refs. Ottawa, 1954. [See *R.A.E.*, A **43** 184.]

Geigy (R). & Herbig (A.). **Erreger und Überträger tropischer Krankheiten.** [Causal Agents and Vectors of tropical Diseases.]—*Acta trop.* suppl. 6, 9½ × 6¾ ins., xxiv + 472 pp., 46 pls. (6 col.), 17 figs., 25 pp. refs. Basle, 1955. Price *Fr.* 80.

This book, which is based partly on the authors' experience in Africa and South America, is divided into four main parts. The first comprises an introductory survey of tropical diseases of man and domestic animals that are transmitted by arthropods, the modes of transmission, and the arthropods responsible for it. The second part, which makes up most of the book, is devoted to arthropods as vectors and the organisms transmitted by them, those considered being: mosquitos and the malaria parasites (with very brief sections on yellow fever and dengue); Simuliids and *Onchocerca volvulus*; *Phlebotomus* and *Leishmania donovani*, *L. tropica* and *L. brasiliensis*; Triatomines and *Trypanosoma cruzi*; *Glossina* and the trypanosomes that cause sleeping sickness and trypanosomiasis of animals; fleas and the plague bacillus; *Pediculus humanus humanus* L., *P. h. capitis* Deg. and *Rickettsia prowazekii* (typhus); *Ornithodoros moubata* (Murr.) and *Spirochaeta* (*Borrelia*) *duttoni* (African relapsing fever); other ticks and agents of piroplasmosis and anaplasmosis; and Trombiculids and *Rickettsia orientalis* (tsutsugamushi disease). Information is in most cases given on the distribution, morphology and bionomics of the vectors and the development cycles and recognition of the causal agents, and on techniques used in studying them. There is also a section on intestinal protozoa of man, with incidental notes on the possible relation of flies or cockroaches to their spread. The third part concerns arthropods as the causal agents of disease, those considered being *Tunga penetrans* (L.) and flies that cause various types of myiasis; and the fourth is a survey of techniques and materials used in the preservation and preparation of specimens and the culturing of pathogenic organisms.

The legends to the numerous illustrations are in English and French as well as German, and there is a classified bibliography to the whole that also deals with vector control, with brief introductory notes.

Hirst (L. F.). **The Conquest of Plague. A Study of the Evolution of Epidemiology.**—8¾ × 5½ ins., xvi + 478 pp., 6 pls., 16 figs., 3 maps, many refs. London, G. Cumberlege, Oxford Univ. Press, 1953. Price £2 2*s*.

This book is divided into four main parts. The first is devoted to a review of traditional beliefs about the cause of plague. In the second, modern conceptions of its nature are discussed in chapters dealing, respectively, with the bacillus, rats and plague, fleas as vectors, plague among the rodents of the great plains, and interhuman plague (pneumonic plague and the possible transmission of plague from man to man by ectoparasites). The subjects of the third part (the spread of plague in time and space) include the periodicity of epidemic diseases, annual variations in the prevalence of plague, its world distribution, migratory movements of rats in relation to its spread, its dissemination in merchandise and the relative importance of rats and fleas in this connection, its limited spread in modern times, modern immunity of temperate regions from it, and its spread in India and Ceylon. Control is dealt with in the fourth part. Two aspects are considered. These are international measures, such as maritime quarantine and international sanitary conventions, to prevent the disease from spreading from country to country, mainly by the prevention of the international transport of infected rats and fleas, and measures directed

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against bubonic plague within a country. These latter are dealt with historically. The modern ones include large-scale rat control, eradication of foci of infection and prevention of spread of the disease inland by attacking infected rat populations with traps, fumigants, etc., and their fleas with DDT sprays applied to rat haunts and DDT dusts to people and grain lorries, personal protection by the use of repellents, insecticides and protective clothing against flea-bites, immunisation and chemoprophylaxis, and treatment by serum therapy and prophylaxis and chemotherapy. There is a bibliography at the end of each part. The measurement of rat-flea densities and of the plague-transmitting power of fleas, the part played in transmission by blood-sucking ectoparasites other than fleas, and the appetite of rat fleas for human blood are the subjects of appendices.

Macchiavello (A.). **Reservoirs and Vectors of Plague.**—*J. trop. Med. Hyg.* **57** nos. 1–12 pp. 3–8, 45–48, 65–69, 87–94, 116–121, 139–146, 158–171, 191–197, 220–224, 238–243, 275–279, 294–298, many refs. London, 1954.

Lists are given of fleas of cosmopolitan distribution and fleas of limited distribution (from Africa, Argentina, Ecuador, Peru, the United States, Hawaii and Asia including the Soviet Union) that are known to be vectors of plague; fleas that have been found naturally infected but are not known to be vectors, and fleas that have been infected only experimentally. In each case, the reference to the original description of the flea is given, together with the name of the investigator who proved its infection or its vector capacity, the date and place of the finding and bibliographical reference. The vector efficiencies [*cf. R.A.E.*, B **30** 33] of certain fleas, estimated from experiments by Eskey & Haas, Wheeler & Douglas and the author, are shown in a table.

Similarly annotated lists are given of rodents and other mammals spontaneously or experimentally infected with plague and of mammals and birds on which infected fleas have been found. There are also an alphabetical list of the plague-infected fleas showing the hosts on which each is known to occur, a systematically arranged index to the mammals and birds, and a list of plague-infected rodents classified according to zoogeographical areas.

Rozeboom (L. E.). **Hybridization among Mosquitoes and its possible Relation to the Problem of Insecticide Resistance.**—*J. econ. Ent.* **47** no. 3 pp. 383–387, 17 refs. Menasha, Wis., 1954.

Certain problems concerning the status and relationship of mosquitos belonging to complex species or groups of species and results obtained in efforts to solve them are reviewed. Cytological studies by G. Frizzi suggest that some of the members of the complex of *Anopheles maculipennis* Mg. may be comprised of genetically distinct populations. He observed that individuals of *messeae* Flni. from various sampling stations in the Province of Pavia might show a standard arrangement for the X chromosome (most frequent in hilly regions) or a very extensive and complex arrangement (more frequent in the Po valley) and that naturally occurring heterozygotes were few. He suggested that sexual isolation might keep the two populations separated. In North America, where there are five members of the *maculipennis* group, it has been shown that *A. aztecus* Hffm. and *A. freeborni*

Aitken are more closely related to one another than to *A. quadrimaculatus* Say [*R.A.E.*, B **43** 44]. The relationship of *A. earlei* Vargas and *A. occidentalis* D. & K. to one another and to the first three needs to be determined by hybridisation experiments, and it would be interesting to ascertain whether there may be chromosomal differences like those observed by Frizzi in the European forms.

Mating and selection experiments by the author and Gilford [**43** 67] with American forms of *Culex pipiens* L. indicated that *molestus* Forsk. is not specifically distinct from *pipiens* or *fatigans* Wied. (*quinquefasciatus*, auct.), though Laven found that there are populations of *molestus* in Europe that appear to be separated genetically from one another [*cf.* **41** 120; **43** 49]. Of the 18 species and subspecies belonging to the complex of *Aëdes scutellaris* (Wlk.), *A. polynesiensis* Marks and *A. pseudoscutellaris* (Theo.) are of special interest [*cf.* **41** 161; **42** 85, 91]. Using *polynesiensis* from American Samoa, the author carried out experiments to determine whether they could hybridise. The results for the F_1, F_2 and F_3 generations, which are given in a table, show that no difficulty was experienced in establishing vigorous hybrid colonies from both crosses [*cf.* **42** 161]. The control colony of *A. pseudoscutellaris* died out. The F_1 hybrid eggs of both crosses were less fertile than those of the parent strains.

Instances are given of characters shown to be controlled by single recessive genes and of others believed to be controlled by several genes. The fact that the crossing of *A. aegypti* (L.) with *A. albopictus* (Skuse) [**40** 105–106] and of strains of *C. p. molestus* often results in fertility being shown in one direction only could be explained on the basis of cytoplasmic inheritance [**40** 107; **41** 120; **43** 49]. Work on the mechanism of inheritance of resistance to insecticides is considered desirable. Hybridisation studies with mosquitos have shown that the populations are dynamic. Therefore, through mutations and adaptations, they may be able to adjust themselves to environmental changes [**42** 105; **43** 44].

King (J. C.). **The Genetics of Resistance to DDT in** *Drosophila melanogaster*.—*J. econ. Ent.* **47** no. 3 pp. 387–393, 3 graphs, 11 refs. Menasha, Wis., 1954.

The author describes experiments in which lines of *Drosophila melanogaster* Mg. were developed from a laboratory stock and from a batch of wild flies collected in New York in July 1952, by exposing the adults to a DDT aerosol for 4, 8, 16, 24 or 32 minutes and breeding from the survivors of treatments that gave over 95, over 90 and about 50 per cent. mortality. At the high level of selective intensity, every other generation was started by a single female survivor and the alternate generations were left untreated, at the intermediate level alternate generations were started by ten female survivors, and at the low level all survivors were used as parents in each generation. Comparison of median lethal exposure times showed no significant difference in resistance between the two unselected stocks, and the treated lines from the laboratory stock showed no measurable response to selection continued through 20 generations, whereas the lines developed from the wild stock at the low level of selective intensity showed a significant and the other treated lines an insignificant increase in resistance. Two crosses between lines gave intermediate resistance in the F_1 generation, and lower resistance and greater variance in the F_2 generation than in the F_1. All the evidence indicates that resistance is determined by a complex polygenic system of genetic factors.

Crow (J. F.). **Analysis of a DDT-resistant Strain of** *Drosophila*.—*J. econ. Ent.* **47** no. 3 pp. 393–398, 8 graphs, 2 refs. Menasha, Wis., 1954.

In an attempt to duplicate to some extent the conditions under which strains of insects develop resistance to DDT in nature, *Drosophila* was bred in cages in which DDT was applied to the inside surface in concentrations that were increased at irregular intervals over a period of three years. The initial population was a heterogeneous mixture of wild and laboratory stocks, to provide as wide a genetic base as possible for selection. Adult flies were tested for resistance after selection for six months and three years, by exposing them, and controls, for 6 or 24 hours to filter papers bearing deposits ranging from 0·6 to 5,120 μg. DDT per sq. cm. They showed an increase in resistance at both exposure periods, but whereas the median lethal deposit for the short exposure was six times as great after three years, that for the longer one was 2,000 times as great. By either criterion, resistance increased about as much in the first six months of selection as in the remainder of the three years. Testing by topical treatment of individual flies with DDT in acetone showed median lethal doses of 0·018 and 0·073 μg. DDT for unselected and selected males and 0·03 and 0·127 μg. for unselected and selected females, the ratio of resistance (about 4:1) being comparable with that revealed by the shorter exposure to deposits. The difference in resistance shown at the two exposure periods did not appear to be due to different sets of genetic factors that come into effect in relation to different exposure periods and concentrations, since selection applied to a non-resistant strain by means of 3-hour and 24-hour exposures led to strains with indistinguishable resistance patterns.

Analysis of the development of resistance and tests of the F_1 and F_2 hybrids between the control flies and the resistant strain selected for three years suggested polygenic inheritance. No appreciable reversion to susceptibility took place after three years without further contact with DDT in the resistant strain selected for six months.

Quarterman (K. D.), Mathis (W.) & Kilpatrick (J. W.). **Urban Fly Dispersal in the Area of Savannah, Georgia.**—*J. econ. Ent.* **47** no. 3 pp. 405–412, 6 refs. Menasha, Wis., 1954.

The dispersal habits of the common species of flies in urban areas in the United States were studied in Savannah, Georgia. The flies used were trapped at the sites chosen as release points, marked by allowing them to feed for 24 hours on milk containing radioactive material (1 microcurie per ml. milk) and sometimes by dusting with dyes also, and released at night. Phosphorus (P^{32}), calcium (Ca^{45}) and iodine (I^{131}) were used in marking, and the dyes served to distinguish different groups marked with P^{32}. Ca^{45}, which was used as calcium chloride, proved unsuitable as it caused high mortality among the flies. It is also rapidly excreted, and no dispersal data were obtained for the flies marked with it. The iodine also caused considerable mortality among male flies. Flies marked with phosphorus and iodine were separated by the differences in types of emissions. A shield stopped the phosphorus β particles, whereas the more penetrating γ rays were admitted to the Geiger counter.

The following is based on the authors' summary of the results. Dispersal was rapid, continuous and independent of direction. Flies often passed in opposite directions to reach the sites at which they were trapped. They concentrated in greater numbers in areas very attractive to them. Large numbers of *Callitroga macellaria* (F.) and some of all species were recovered

in vacant areas considerably removed from major fly-breeding foci. Sources of heavy breeding near the city were found to contribute substantially to the city's fly population. Flies from dairies, an abattoir and a garbage dump situated outside the city moved into all parts of the city and right across it.

Of the marked house-flies (*Musca domestica* L.) and the blowflies of the genus *Lucilia* (*Phaenicia*) recovered, most were trapped within half a mile of release points, though about one-third of the house-flies were trapped more than a mile away in one test. Most of the individuals of *C. macellaria* recovered were trapped 1–4 miles from release points. The longest distances in miles were 7·6 for *M. domestica*, 7·2 for *C. macellaria*, 5 for *L. cuprina cuprina* (Wied.) (*pallescens* Shann.), 3·5 for *L. sericata* (Mg.) and *Fannia pusio* (Wied.) and 2·1 for *Sarcophaga sueta* Wulp. If the recovery of marked flies per trap were adjusted to equalise the traps in each one-mile zone on the basis of land area served by each trap, the results would indicate that large numbers of flies moved into each one-mile zone up to four miles or more from the release points.

It is concluded that municipal fly control should be city-wide and should in some instances include the most important of the immediately outlying foci of production.

Quarterman (K. D.), Kilpatrick (J. W.) & Mathis (W.). **Fly Dispersal in a rural Area near Savannah, Georgia.**—*J. econ. Ent.* **47** no. 3 pp. 413–419, 1 fig., 3 refs. Menasha, Wis., 1954.

The following is based on the authors' summary. Dispersal tests were carried out in rural areas of south-eastern Georgia with natural populations of *Musca domestica* L. and *Callitroga macellaria* (F.) obtained by trapping adults on the premises used as release points. The flies were marked with radioactive phosphorus and, if necessary, with dyes also [*cf.* preceding abstract], and were released at dusk on the premises on which they had been caught. One release point was used in the first test, carried out at the beginning of May, and five simultaneously in the second, in late June. *M. domestica* was recovered up to five miles from the release points in less than 24 hours. The range and pattern of its flight were similar to those of *C. macellaria*, although the higher percentages of *C. macellaria* taken in the recovery traps tended to substantiate the belief that it is the more migratory of the two.

In both tests, the flies apparently dispersed at random over an area 8–10 miles in diameter, with a few individuals trapped up to ten miles from the release point. Within the general dispersal area, the flies tended to congregate more at premises where food and breeding material were more favourable. The availability of these materials, however, did not prevent great numbers of flies from leaving any given situation. It appears that movement over this relatively large area is a normal pattern of fly activity.

Fuller (H. S.). **Experimental Epidemiology in Relation to Arthropod-borne Disease.**—*J. econ. Ent.* **47** no. 3 pp. 420–429, 42 refs. Menasha, Wis., 1954.

Experimental epidemiology (the study under controlled laboratory conditions of the factors governing fluctuations in the incidence of disease in a group) has always been an important part of the study of arthropod-borne disease. The present discussion of the potentialities of the method in this

connection is divided into four main parts. These deal with basic principles; applications of quantitative methods, with particular reference to determination of vector efficiency [*R.A.E.*, B **30** 33]; experimental models, in which a study is made of systems composed of populations of suitable vectors, pathogens and susceptible animal hosts (illustrated largely by the work of Bertram on one system [**41** 7, etc.] and including discussions of the possible application of the method to six others); and the broader aspects of these experimental approaches. A summary is given of the current major limiting factors in the experimental determination of vector efficiency in 18 vector-pathogen combinations to which the concept is theoretically applicable.

Traub (R.), Newson (H. D.), Walton (B. C.) & Audy (J. R.). **Efficacy of Dieldrin and Aldrin in Area Control of the Chigger Vectors of Scrub Typhus.**—*J. econ. Ent.* **47** no. 3 pp. 429–435, 24 refs. Menasha, Wis., 1954.

The effectiveness of dieldrin or aldrin applied to the ground for the control of the Trombiculid vectors of tsutsugamushi disease (scrub typhus) was investigated in North Borneo in 1953 in areas with a very thick growth of typical scrub vegetation. The degree of control was evaluated by counting the Trombiculid larvae in the ears of rats (*Rattus rattus* and *R. müller*i) taken in the open and of others exposed in an enclosure. About half the larvae collected from the rats were *Trombicula deliensis* Walch, an established vector of tsutsugamushi disease, and virtually all of the other half were *T. wichmanni* (Oudm.). Dieldrin and aldrin applied in undiluted emulsifiable concentrates as fine-mist sprays at 2·25 lb. (technical grade) per acre so reduced populations that averages of only three and 11, respectively, were found in the ears of each wild-caught rat 2–3 days after spraying, whereas rats from a control area had an average of 850 each. More than five weeks after application, there were nearly 75 and 25 times as many larvae on wild-caught rats trapped in the untreated area as on those in the plots treated with dieldrin and aldrin, respectively. The average numbers on the rats had fallen to 2 and 4 per cent. of the numbers 1–5 days before spraying in the areas treated with dieldrin and aldrin, whereas the numbers in the untreated area had risen slightly. The full duration of effectiveness was not determined, but observations on rats released in the fenced areas indicated that it was not less than eight weeks despite intervening periods of rainfall. It has been shown that the risk of infection with tsutsugamushi disease in a given locality varies with the average number of vector mites per wild rat [*cf. R.A.E.*, B **41** 6].

Langford (G. S.), Johnson (W. T.) & Harding (W. C.). **Bait Studies for Fly Control.**—*J. econ. Ent.* **47** no. 3 pp. 438–441, 9 refs. Menasha, Wis., 1954.

Three phosphorus compounds, malathion, Diazinon [O,O-diethyl O-2-isopropyl-4-methyl-6-pyrimidinyl thiophosphate] and Bayer L 13/59 [dimethyl 2,2,2-trichloro-1-hydroxyethylphosphonate] were outstanding among 27 chemicals tested in sugar solutions as baits to control house-flies [*Musca domestica* L.] in the laboratory and under field conditions in Maryland. Because of the low toxicity of malathion to warm-blooded animals, further extensive tests of baits prepared with it were made in a variety of situations. The concentration of malathion was varied from 0·5 to 2 oz. of 57 per cent. emulsion concentrate and the concentration of sugar from

0·5 to 2 lb. in 1 U.S. gal. water. The baits were effective in barns regardless of concentration, when applied daily or every other day to the concrete floors with a sprinkling can or to the window ledges, door jambs, stanchion pipes and overhead beams as a coarse spray. Between 2 and 3 U.S. gals. bait was usually enough to treat a dairy barn with 40–50 stalls. The length of time the barns remained free of flies after the last application varied considerably regardless of the concentration of poison or sugar, but it was usually greater when these were high. The longest period of protection was two weeks. A bait containing 1 U.S. gal. of 57 per cent. malathion concentrate, 50 lb. sugar and 100 U.S. gals. water was used to spray all the garbage bins in one small town with promising results. There were indications that 90–95 per cent. of the flies (*M. domestica* and blowflies) in the immediate neighbourhood of the bins were killed and that the fly population of the town as a whole was halved.

Baits containing chlorinated hydrocarbons killed non-resistant flies under laboratory conditions but were unsatisfactory in the field. Baits containing CS 708 [a 1:2 mixture of 1,1-bis(p-chlorophenyl)-2-nitropropane and 1,1-bis(p-chlorophenyl)-2-nitrobutane] gave fair control under field conditions, but were inferior to those containing organic phosphates. Several miscellaneous products, including borax, copper sulphate, formalin, sodium fluoride and rotenone, that were included in the tests, were relatively ineffective.

Madden (A. H.), Tozloski (A. H.) & Sweetman (H. L.). **Control of *Myobia musculinus* (Schrank) and *Myocoptes musculinus* (Koch) on Laboratory Mice.**—*J. econ. Ent.* **47** no. 3 pp. 442–444, 1 graph, 4 refs. Menasha, Wis., 1954.

Myobia musculi (Schrank) [which is cited throughout this paper as *M. musculinus* (Schrank)] and *Myocoptes musculinus* (Koch) are common parasites of laboratory mice; though widely separated taxonomically, they have similar habits. Apparently neither of these mites sucks blood, both being reported to feed on oily secretion in the hair follicles. The constant irritation caused by heavy infestations debilitates the hosts, which may also damage themselves severely by scratching. Control with dusts was studied on a colony of mice in Massachusetts in 1952. It is stated that chemical control of ectoparasites of laboratory mice is restricted to the use of dusts, as spraying is too laborious and dipping involves the risk of pneumonia in the hosts [*cf. R.A.E.*, B **42** 40]. Preliminary tests with several materials including Ovotran (p-chlorophenyl p-chlorobenzenesulphonate), Neotran (di(p-chlorophenoxy)methane), Aramite [2-chloroethyl 2-(p-tert.-butylphenoxy)-1-methylethyl sulphite], DDT and lindane [γ BHC] indicated that lindane was the most promising. In subsequent tests, it was compared with sulphur and chlordane. A pinch of the material was sometimes applied directly to the body and rubbed into the fur, but lindane and chlordane were generally sprinkled over the fresh bedding and the sulphur applied to the mice by shaking them with a little powder in a closed container before they were returned to a clean cage. Heavily infested mice carried 1,000–1,500 mites. Estimation of results was partly qualitative, but numbers were counted when the hosts were killed at the end of the tests. No distinction was drawn between the two species as no appreciable difference was observed in their reactions. No treatment materially harmed the mice, but as lindane and chlordane are toxic to warm-blooded animals, and must be used with care, sulphur is preferable in this respect. Test periods varied from 18 to 84 days, with retreatments in most cases.

Lindane at 0·5 per cent. was unsatisfactory, even with frequent retreatments. Lindane at 1 per cent., applied frequently to animals or bedding and chlordane at 5 per cent. applied to bedding gave good results, but neither was so effective as 100 per cent. 325-mesh dusting sulphur, of which one application generally gave good control for several weeks. Sulphur sometimes gave good incidental control of *Polyplax serrata* (Burm.), but this louse was eradicated by sprinkling 2 gm. of 5 per cent. chlordane over the fresh bedding. Chlordane was compatible with sulphur, and the combination was harmless to the mice.

McGregor (W. S.), Radeleff (R. D.) & Bushland (R. C.). **Some Phosphorus Compounds as Systemic Insecticides against Cattle Grubs.**—*J. econ. Ent.* **47** no. 3 pp. 465–467, 10 refs. Menasha, Wis., 1954.

The literature on attempts to control ectoparasites by introducing insecticides into the blood-stream of the host is briefly reviewed, and preliminary studies with four organic phosphorus compounds against larvae of *Hypoderma* [*lineatum* (Vill.)] in cattle are recorded. These four compounds had shown promise in tests in which various materials were injected subcutaneously in solutions into guineapigs infested before treatment and at intervals after it with young larvae of *Callitroga hominivorax* (Coq.). Diazinon (O,O-diethyl O-2-isopropyl-4-methyl-6-pyrimidinyl thiophosphate) was administered to the cattle subcutaneously in a 5 per cent. solution in refined groundnut oil and also orally in an emulsion. The remaining compounds were administered orally, chlorthion (O,O-dimethyl O-3-chloro-4-nitrophenyl thiophosphate) in an emulsion, Bayer 21/199 (O,O-diethyl O-3-chloro-4-methyl-7-coumarinyl thiophosphate) in a suspension, and Bayer L 13/59 (dimethyl 2,2,2-trichloro-1-hydroxyethylphosphonate) in an aqueous solution. Treatment was given once only, when larvae had appeared in the backs. When injected, Diazinon at all doses (5, 10, 25 and 50 mg. per kg. body weight) killed all larvae present in the backs of the animals and all those that appeared within two weeks. The 10-mg. dose was not completely effective in the third week, and none was effective in the fourth. The lowest dose could not be satisfactorily evaluated after the first week because no larvae appeared during the second and third weeks. By oral administration, Diazinon at 10 and 25 mg. per kg. killed nearly all the larvae present. The lower dose killed all new larvae for one week but not for two. No new larvae appeared after treatment at the higher dose. Bayer L 13/59 was tested at doses of 25, 50 and 100 mg. per kg. and gave excellent kill of the larvae present at treatment. The highest dose gave complete kill of new larvae for two weeks, partial kill in the third week and no kill in the fourth. No new larvae appeared during the four-week observation period after treatment with the two lower doses. Chlorthion was tested at 50 mg. per kg. and killed about 66 per cent. of the larvae present. No more appeared during the first and second weeks, and those appearing in the third and fourth weeks were not killed. Bayer 21/199 was tested at 25 mg. per kg. and was completely ineffective at the time of treatment and during the four-week observation period.

Eddy (G. W.), Cole (M. M.) & Burden (G. S.). **Synergists with Allethrin against the Body Louse.**—*J. econ. Ent.* **47** no. 3 pp. 501–506, 8 refs. Menasha, Wis., 1954.

The following is based on the authors' summary. During 1951–53, 203 compounds were tested in the laboratory as synergists with allethrin against

Pediculus humanus humanus L. All were evaluated in beaker tests as solutions for impregnating cloth [*cf. R.A.E.*, B **34** 44] and 37 also as powders prepared with pyrophyllite. The ratio of synergist to allethrin was 10:1. In the beaker tests, the minimum lethal concentration was nearly always determined and the duration of effectiveness also for all materials that showed promise. Powders applied to cloth were evaluated from the point of view of lasting effect only. The materials are given class ratings from 1 to 4 (4 being the best), based on their effectiveness in different tests. Sulfoxide (1,2-methylenedioxy-4-(2-(octylsulphinyl)propyl)benzene), which was highly effective as a synergist, was chosen as a standard. On the basis of minimum lethal concentration, 11 materials proved more effective as synergists than sulfoxide. Some increased the toxicity of allethrin 10–20 times or more. On the basis of lasting effectiveness both as solutions and as powders, nine materials appeared about equal to or slightly more effective than sulfoxide. They were Sulfone 12672 (1,2-methylenedioxy-4-(2-(octylsulphonyl)propyl)benzene), the dibutylpiperonylidene ester of malonic acid and the α-allylpiperonyl, α-amylpiperonyl, α-ethylpiperonyl, α-butylpiperonyl, α-tert.-butylpiperonyl, α-(2-methylallyl)piperonyl and 4-(3,4-methylenedioxyphenyl)sec.-butyl esters of chrysanthemic acid. The first five had ratings of three and the last four ratings of four for minimum lethal concentration.

Neel (W. W.). **Control of Human Bot Fly on Cattle.**—*J. econ. Ent.* **47** no. 3 pp. 540–541, 7 refs. Menasha, Wis., 1954.

Sprays containing 0·5 per cent. toxaphene or 0·15 per cent. aldrin in emulsified solution or a combination of 0·5 per cent. DDT with 0·03 per cent. γ BHC in wettable-powder suspension were compared for the control of *Dermatobia hominis* (L. jr.) on cattle in Costa Rica during the rainy season. The sprays were applied fortnightly from 30th September 1952 to 20th January 1953 at a pressure of 250–300 lb. per sq. inch and a rate of 3 U.S. quarts per animal. They caused a progressive and significant reduction in infestation, but did not differ significantly in effectiveness. The average numbers of larvae per animal at the beginning and end of the experiment were roughly 64 and 5–9 on the sprayed cattle and 64 and 42 on the controls.

Horsfall (W. R.). **A Migration of *Aedes vexans* Meigen.**—*J. econ. Ent.* **47** no. 3 p. 544, 5 refs. Menasha, Wis., 1954.

During limited migrations by *Aëdes vexans* (Mg.), the mosquitos keep close to the ground, but rapid distribution at higher altitudes occurs under some conditions [*cf. R.A.E.*, B **30** 38]. An account is given of an extensive invasion by *A. vexans* experienced over hundreds of square miles in central and northern Illinois early in September 1953, and evidence is adduced that the mosquitos had come from parts of Wisconsin 90–230 miles away in 24–48 hours as a result of the displacement of air associated with the southward passage of a massive cold front on 3rd–4th September. The rainy weather and consequent flooding necessary to produce such large numbers had not occurred anywhere nearer. Some females were collected in the southern tip of Illinois on 16th September where none had existed in August. If these formed part of the same invasion, they had travelled 460 miles or more.

Vinogradskaya (O. N.). **The Participation of the Tracheal System in the Evaporation of Water in *Anopheles maculipennis messeae* Fall. and the seasonal Variation in the Spiracle Index in Species of the Subfamily Culicinae (Diptera, Culicidae).** [*In Russian.*]—*Ent. Obozr.* **33** pp. 157–160, 2 graphs, 9 refs. Moscow, 1953.

Insects lose water by evaporation through the cuticle covering the body or through the surfaces of the tracheae, and an account is given of tests to discover which of the two ways is the more important in *Anopheles maculipennis messeae* Flni. Since a content of 1 per cent. carbon dioxide in the air causes this mosquito to keep its thoracic spiracles almost constantly open, males and females were exposed for 30 minutes at temperatures of 22–26°C. [71·6–78·8°F.] to dry air containing 2–3 per cent. carbon dioxide or virtually none. Their loss of water was estimated from their weights before and after exposure. The percentages of weight lost by the mosquitos exposed to carbon dioxide and (in brackets) the others were 12·33 (3·21) for females in different stages of blood digestion taken from day-time shelters, 23·6 for newly emerged females, and 23·1 (1·9) for newly emerged males. Since the water loss was so much greater for the mosquitos induced to keep their spiracles open, it is concluded that evaporation proceeds mainly through the surfaces of the tracheal system, and this is in agreement with earlier findings as to the differences in size of the spiracular openings in different species of *Anopheles* [*cf. R.A.E.*, B **31** 188; **37** 27; **41** 84]. Differences in the thoracic spiracle index [**31** 188] were likewise found to exist in other mosquitos (*Aëdes* spp., *Culex pipiens* L. and *Culiseta* (*Theobaldia*) *silvestris* Shingarev). The variations in the indices in these mosquitos are shown on graphs. The indices were larger in *Culex* and *Culiseta*, the hygrophilous *A. cinereus* Mg. and *A. excrucians* (Wlk.), and *A. cataphylla* Dyar and *A. dorsalis* (Mg.), which occur in spring, than in *A. caspius* (Pall.) and *A. vexans* (Mg.), which are summer species and comparatively resistant to dryness. It was also found that within the same species (*A. caspius* and *A. vexans*) the indices were larger in adults that emerged in spring than in those that did so in summer, which is probably an adaptation to seasonal conditions. In females of *Anopheles m. messeae* taken near Moscow, the indices were larger at the beginning and end of the summer than at mid-summer.

Lineva (V. A.). **On the physiological Age of Females of the House-fly *Musca domestica* L. (Diptera, Muscidae).** [*In Russian.*]—*Ent. Obozr.* **33** pp. 161–173, 9 figs., 24 refs. Moscow, 1953.

The author records the results of observations on the structure and functioning of the ovaries in *Musca domestica* L. and shows that they are covered by a tracheal system resembling that of *Anopheles* [*cf. R.A.E.*, B **34** 180]. Similar changes took place in this tracheal system with the maturation of the first batch of eggs, the nodules of tracheoles gradually separating and not reforming after oviposition. The presence of nodules is thus an indication that a female has not oviposited. As in the case of other flies [*cf.* **32** 52], yellow bodies (corpora lutea) were found in females that had oviposited. They were confined to the base of the ovarian tube in females that had laid 1–3 egg-batches, but extended along the tube itself in those that had laid more. Use of these two criteria therefore permits females of three physiological age-groups to be differentiated.

Dolmatova (A. V.). **Differences in the ecological Requirements of certain Species of Sandflies (*Phlebotomus*): Shelters, Circulation in Shelters.** [*In Russian.*]—*Med. Parazit.* 1954 no. 1 pp. 33–42, 5 graphs. Moscow, 1954.

Observations over a number of years in inhabited places in different parts of the Soviet Union showed that species of *Phlebotomus* that differ in ecological requirements can co-exist in the same locality, and frequently in close proximity, owing to the difference in the microclimate of their day-time shelters. *Phlebotomus papatasi* (Scop.), *P. major* Annan. and *P. chinensis* Newst. were found in the same town in southern Crimea, but the first two species were in inhabited houses where the temperature was 22–28°C. [71·6–82·4°F.] and the third in a cellar where it was lower by 2–4°C. [3·6–7·2°F.]. The relative humidities in the places where the three species occurred were 40–70, 40–90 and 40–90 per cent., respectively, *P. major* preferring places where there was little light and no draught. In a settlement in a dry area at high altitude near Stalinabad (western Tadzhikistan), *P. papatasi* was common in ill lit inhabited houses with low ceilings and earthen floors, whereas *P. chinensis* occurred about 220 yards away in loess caves which were much damper and cooler than the houses. In a village in Azerbaijan, *P. papatasi* and *P. tobbi* Adl. & Thdr. occurred together in inhabited houses in which the temperature was 20–30°C. [68–86°F.], but the former predominated in those in which the range of humidity was narrow (50–70 per cent.). One of these houses was a crèche in which no people remained overnight, and the presence of many newly emerged sandflies in the mornings indicated that they bred there. *P. tobbi* was the more numerous species in houses shaded by trees, with a humidity of 65–80 per cent., but was most numerous in a stable nearby in which the temperature fluctuated between 20 and 34°C. [68–93·2°F.] and humidity from 20 per cent. at midday to 80 per cent. at night. It and *P. papatasi* constituted 92·5 and 6·8 per cent. of all the sandflies found in this stable. *P. kandelakii* Shchurenkova occurred in small numbers in all the shelters examined and was most numerous in the shaded houses with high humidity.

The hours during which houses were entered by *P. papatasi* and *P. perfiliewi* Parr. in south-eastern Crimea, *P. major* in southern Crimea, and *P. papatasi* and *P. tobbi* in Azerbaijan are recorded. Most individuals of all these species entered houses between dusk and midnight and a few between midnight and dawn, but some species entered later than others, partly because a higher humidity was required for their evening activity to begin. Thus, *P. papatasi* entered in numbers between 8 and 9 p.m., but *P. perfiliewi* did not do so until 10 p.m. when the relative humidity rose from 42 to 60 per cent. Entry of *P. major* showed two peaks, the first between 8 and 9 p.m. when the humidity at the place of observation was 70–80 per cent., and the second during the hour after midnight.

Sandflies entering houses could be divided into three groups, endophilous, exophilous and intermediate. The members of the endophilous group, notably *P. papatasi*, remain in the house after feeding, complete blood-digestion there and are less frequently encountered in nature than other species. Those of the exophilous group, such as *P. perfiliewi*, feed chiefly in the open air or leave a house as soon as they have fed in it. Those of the intermediate group, such as *P. major* and *P. sergenti* Parr., feed readily indoors as well as in the open and remain in the houses for blood-digestion if the microclimate is suitable, but as a rule prefer neighbouring outbuildings and natural shelters. The recognition of these groups is of importance in the application of control measures. Experience in different parts of the Crimea has shown that the inhabitants of houses can be effectively protected

from sandflies of the intermediate group by treating the outside of the walls with DDT or BHC, but that treatment within the rooms is also necessary where the predominant species is *P. papatasi*.

ZHOVTŸÏ (I. F.). **A Connection between the seasonal Rises in Dysentery Morbidity and the Phenology of the House-fly,** *Musca domestica* **L.** [*In Russian.*]—*Med. Parazit.* 1954 no. 1 pp. 43–45, 2 graphs. Moscow, 1954.

Observations in 1950 on the activity and breeding of *Musca domestica* L. from May to October in a town in western Siberia showed that the seasonal incidence of cases of dysentery there was correlated with the numbers of the fly and particularly with the extent to which it was moving between its breeding places and feeding sites. The numbers of cases began to increase gradually in May and early June, as the flies became active after the winter, and increased progressively after the emergence of flies of the first, second and third generations in mid-June, early July and August. They fell considerably with the onset of cooler weather when the flies were still numerous at feeding sites but were no longer migrating to any extent from their breeding places, and had dropped to the low winter level by the beginning of November, when the flies had ceased to be active.

TAGIL'TSEV (A. A.). **The Application of a Hexachlorane Substratum for treating the Burrows of Rodents.** [*In Russian.*]—*Med. Parazit.* 1954 no. 1 pp. 57–58. Moscow, 1954.

A brief account is given of experiments in south-western Kirgizia in which a dust of 0·5 per cent. technical BHC in loess blown into the burrows of *Meriones erythrourus* eliminated fleas and other insects from them. Ticks were scarce in these burrows, but the author had previously shown that a BHC dust blown into the burrows of domestic rodents destroyed *Ornithodoros* (*Alectorobius*) *tholozani* (Lab. & Mégn.).

KUVŸCHINSKIÏ (B. S.). **Something new in the Control of Sandflies under natural Conditions in the Open.** [*In Russian.*]—*Med. Parazit.* 1954 no. 1 pp. 60–61. Moscow, 1954.

The effectiveness against *Phlebotomus* of a BHC aerosol released from a fog generator was tested near Yalta in southern Crimea in July 1950. A 4 per cent. solution of technical BHC in solar oil was applied from a moving machine to a total surface of about 500 acres at an average rate of 2·3 oz. BHC per acre. Applications were made during the evening, night and early morning hours of 12th–13th and 20th–21st July, and the second was the more effective owing to the experience gained in the first. Sandflies in muslin cages at distances of up to 55 yards from the path of the machine all became paralysed within 10–20 minutes and died within 1–3 hours, and fresh sandflies introduced into the cages during the ensuing 24 hours died within 3–5 hours. The abundance of sandflies in the treated area was greatly reduced for a few days, but then returned to normal owing to the emergence of a new generation and to immigration.

Morozovskaya (M. I.) & others. **Antimalaria Measures in the Zone of Construction of the Kakhovka Hydroelectric Station.** [*In Russian.*]—*Med. Parazit.* 1954 no. 1 pp. 61–66. Moscow, 1954.

A hydroelectric station is being constructed at Kakhovka on the lower Dnieper in a densely populated area to which numbers of workmen have been brought from other parts of the Soviet Union. The area within a radius of three miles includes a total surface of some 19 sq. miles of waters in which Anophelines breed. The chief malaria vector is *A. maculipennis messeae* Flni., which shelters during the day in animal quarters and inhabited houses and to a considerable extent also in tree hollows. *A. hyrcanus* (Pall.), which shelters chiefly in the dense growths of reeds, may also be an important vector in places where people spend the night in the open. Larvae of *A. m. messeae* can be found in all kinds of flood water and also in shallows along the edges of the Dnieper where it is bordered with vegetation. They are present in shallow pools covered with meadow vegetation from April until the floods recede in June, and then occur in water covered with aquatic vegetation. The temperature of the breeding places rises above 10°C. [50°F.] in April and remains favourable for the development of the larvae till mid-September, so that 5–6 generations of mosquitos are produced during the summer.

Malaria was formerly rife in the region, but its incidence was reduced during 1948–50, mainly by the treatment of houses with DDT or BHC. The construction scheme, however, involved work and housing in close proximity to the breeding places of the Anophelines, and control measures adapted to each section of the scheme and each inhabited area were planned and adopted. The extent of house treatment with DDT or BHC varied with the size of the settlement concerned. In small ones, with not more than 200 dwellings, all houses in which cases of malaria had been registered and the adjoining outbuildings were treated. In larger ones, the peripheral houses were treated to form barriers ranging in width from some 300 to 550 yards according to the size of the area to be protected. As, however, it was found in 1951 that the barriers alone were not completely effective, all the breeding places in the area were dusted against the larvae from an aeroplane. This resulted in a very great reduction in the Anopheline population of the area as a whole, and in the numbers of females that crossed the barriers, while most of the latter were newly emerged or had oviposited only once. Mosquitos were very abundant throughout the season in an untreated area 12 miles away and included females that had oviposited 4–6 times. As a result of the measures adopted, which also included medical prophylaxis, the incidence of malaria decreased by 85 per cent. in 1951 and no parasite carriers were found in 1952 among the immigrant workmen or the local population. It is recommended that work on the same lines should be continued throughout the entire duration of the construction of the station.

Buyanova (O. F.). **The Importance of Ponds constructed in dry River Beds from the Point of View of Anophelism and Malaria.** [*In Russian.*] —*Med. Parazit.* 1954 no. 1 pp. 66–70, 4 graphs. Moscow, 1954.

It is a common practice in some parts of the Soviet Union to make ponds by impounding water in dry river beds, and it has been observed that such ponds seldom become overgrown with vegetation or infested with mosquito larvae. In 1951, 17 ponds in a hilly district in the Province of Orel were examined to ascertain the cause of this. It was found that ponds in use for household purposes, keeping ducks and watering cattle were practically

free from plants and mosquito larvae, because the vegetation was kept down by the trampling of the cattle and the feeding of the ducks, and the water was kept turbid by constant disturbance. Old disused ponds in the upper parts of the river beds, which contained clear water and were shallow except near the dam, became overgrown in the course of the summer with amphibious and aquatic vegetation where the depth was not more than three feet and showed high infestation with *Anopheles* larvae until the end of July, when they became partly dry and the numbers of larvae were greatly reduced. Newly constructed isolated ponds had little vegetation during their first year and rarely harboured mosquito larvae, but the shallower parts of the lower ponds of a series in the same river bed usually became overgrown with vegetation and formed potential breeding places. Vegetation appeared quickly in ponds on sites in which aquatic plants used to grow. The plant associations of the ponds consisted chiefly of plants that grow in shallow water, and thus the deeper parts of the ponds remained clear of vegetation.

It is concluded that the causes of the paucity of vegetation in these ponds include their isolation from other water, the activity of man, cattle and ducks, the rapid decrease of the water surface in summer, and the fact that the shallow parts of the ponds freeze solid in winter. Mosquitos were scarce or absent in the villages in the area, no fresh cases of malaria had been registered in them for three years, and the importance of the ponds as a source of Anophelines must therefore be small.

Iyengar (M. O. T.). **Vector of Malaria in Kabul, Afghanistan.**—*Trans. R. Soc. trop. Med. Hyg.* **48** no. 4 pp. 319–324, 1 ref. London, 1954.

Kabul, the capital of Afghanistan, is situated at an altitude of about 6,000 ft. on fairly flat land surrounded by hills. It was believed to be free from endemic malaria, because the winters are cold, with minimum temperatures below freezing for four months, and the mild summers are dry, with an average relative humidity of 39–43 per cent. during June–September, but the question was investigated in June–October 1952. Over 3,000 females of *Anopheles* were collected in dwellings and were found to belong to seven species; *A. superpictus* Grassi, *A. stephensi* List. and *A. culicifacies* Giles, which are vectors of malaria elsewhere, made up 66·4, 27·9 and 1·6 per cent., respectively, of the catch. The salivary glands of most of these females were dissected and sporozoites were found in 8 (0·39 per cent.) of 2,059 of *A. superpictus* but not in 864 of *A. stephensi*, 42 of *A. culicifacies* or 85 of three of the other species. The mosquitos were infected in July, August and September, and fresh infections with *Plasmodium vivax* in infants were found in the two latter months. The spleen rate in children was about 10·6 per cent.

Females of *A. superpictus* rested indoors during the day on the walls and ceilings of dark, ill-ventilated and unfrequented rooms and in stables. Here, they were to some extent protected from the low atmospheric humidity that prevails when temperatures are high enough to favour the development of malaria parasites in the mosquito. The immature stages were found in the river and in sunny pools and seepages. There was no evidence of breeding in marshes, ditches or wells. Adults were taken in villages a mile and a half from breeding places. They were also taken at an altitude of 7,500 ft. *A. stephensi* bred in river pools and ditches and *A. culicifacies* in river pools. Anopheline breeding began in June and reached a peak in late July and early August when pools in the river bed are numerous before it dries up altogether. The incidence of adults of *A. superpictus* in houses was highest at the same time. In September and October, they were largely replaced

by *A. stephensi*. Females of *A. superpictus* collected in October showed an accumulation of fat in the abdomen and no full-grown eggs, though they had fed recently.

MASTBAUM (O.). **Observations of two epidemic Malaria Seasons (1946 and 1953)—before and after Malaria Control—in Swaziland.**—*Trans. R. Soc. trop. Med. Hyg.* **48** no. 4 pp. 325–331, 1 graph. London, 1954.

A comparison is made of the incidence of malaria in a rural population in Swaziland in 1946 and 1953, both seasons of epidemic character when breeding by *Anopheles gambiae* Giles, the main vector, was abnormally heavy and widespread, but one before measures for the control of Anophelines had been begun in the area and the other after adult control by insecticide treatment of huts had been practised for 3–4 years. The insecticide that had been used for the last two years was a BHC wettable powder applied at about 20 mg. γ isomer per sq. ft. Huts were sprayed at intervals of three months beginning as soon as larvae were reported, except in 1953, when the interval was shortened to two months; in that year the treated area was extended, as breeding took place in the middle- and high-veld, which are usually free of malaria. In 1945–46 and subsequently, blood slides from about 4,000 children including some 400 infants less than one year old were examined each year, and huts in treated areas were sprayed with a pyrethrum preparation to determine whether vectors were present. Vectors were often absent from huts, though fresh infections were occurring and immature stages were being found. The discrepancy between findings of larvae and of adults was particularly marked in 1953. Apparently, the control measures were driving *A. gambiae* from the huts without eradicating it from the area. However, malaria transmission was being controlled.

The total number of positive cases (mostly caused by *Plasmodium falciparum*) recorded was 5,743 in 1945–46, but only 764 during 1952–53, of which 235 occurred on European farms where control measures could not be enforced. Many cases in native areas adjacent to these European properties were traceable to breeding on the farms, and other cases to huts that were left untreated through failure to obtain access (about 5 per cent.) or to huts that had not yet received their first treatment. During the peak months, March and April, malaria transmission increased greatly in 1946 but decreased in 1953. Parasite rates in children 0–1, 1–5, 6–10 and 11–16 years old were 37, 75, 78 and 57 per cent., respectively, in 1945–46 and 6, 11, 10 and 10 per cent. in 1952–53. It is concluded that even in epidemic years measures against adult mosquitos alone can control malaria effectively in rural areas in Swaziland where irrigation is not practised, if all premises are treated and operations are begun early. In an area with 1,400 acres of land under irrigation for rice-growing, fresh cases of malaria occurred constantly among the natives in spite of hut spraying every six weeks, until anti-larval measures were used as well.

REID (J. A.). **A preliminary *Aedes aegypti* Survey.**—*Med. J. Malaya* **9** no. 2 pp. 161–168, 1 fig., 8 refs. Singapore, 1954.

A brief preliminary survey of the incidence of *Aëdes aegypti* (L.) in five coastal and four inland localities of Malaya was made in June and July 1952 with a view to organising its control at ports as a measure against the introduction of yellow fever. Houses were searched by spraying one room in each with a pyrethrum preparation, and the percentages thus found

to harbour *A. aegypti* were 63, 50, 48, 44 and 0 in the coastal localities and 14, 10, 6 and 0 in the inland ones, the highest percentage being at Port Swettenham. More thorough methods of searching would probably have indicated a higher incidence. *A. aegypti* was confined to towns in inland districts, but occurred outside them on the coast. The factors governing its distribution are not known. *Culex pipiens fatigans* Wied. was the commonest mosquito in houses by day, and was about equally abundant in all localities except one, in which it was very scarce. This place was in a rather isolated narrow rice-growing valley, and was the inland locality in which *A. aegypti* was absent. These two mosquitos are apparently the only ones in Malaya that show a preference for resting in houses by day.

STUEBEN (E. B.). **Larval Development of *Dirofilaria immitis* (Leidy) in Fleas.**—*J. Parasit.* **40** no. 5 Sect. 1 pp. 580–589, 18 refs. Lancaster, Pa., 1954.

The following is based on the author's summary. A study of the relationship between *Dirofilaria immitis* (dog heartworm) and various species of fleas was undertaken to determine the effects of the parasite on a potential intermediate host. Of 1,203 individuals of *Ctenocephalides felis* (Bch.) collected from 71 dogs in Florida, 446 contained larvae of *D. immitis* in advanced stages of development [*cf. R.A.E.*, B **42** 202–203]. When examples of *C. felis* and *C. canis* (Curt.) were restricted to feeding on an infected dog, 98 per cent. became infected. The development of microfilariae of *D. immitis* to infective-stage larvae was traced in both sexes of *C. felis*, *C. canis*, *Xenopsylla cheopis* (Roths.), *Pulex irritans* L., *Echidnophaga gallinacea* (Westw.) and *Orchopeas wickhami* (Baker). The prelarval forms penetrated the midgut wall and entered the abdominal haemocoele of the flea as early as one hour after ingestion, and the first and second stages of larval development occurred there. Third-stage larvae were found in the haemocoele of the abdomen and thorax. Most infective-stage larvae were in the haemocoele of the head and thorax.

Dissections and serial sections of infected fleas showed that no major tissue damage or apparent injury of any organs could be attributed to the developing larvae. The fertility of the male fleas and the egg production of the female fleas were not affected by the larvae infecting them, and the mortality rate of infected fleas was not higher than that of non-infected fleas. The infective-stage larvae were shown to be thermotropic, concentrating in the haemocoele of the head of the flea when warm saline was put in its mouth-parts. They were apparently unable to move out of an unfed flea. In 14 cases, infective larvae escaped through the region of the mouth-parts of fed fleas when the intracoelomic pressure of the flea was increased. Infective larvae were observed leaving the bodies of fleas through injured areas of the exoskeleton, but they could not penetrate intact skin. Before feeding, 28 infected fleas were seen to contain 47 infective larvae. After feeding on a new-born rat, the fleas were dissected and only 17 infective larvae were found to remain. Skin samples taken from the areas bitten by the fleas showed three larvae of *D. immitis* to be present in the punctures made by feeding. This shows that infective larvae can leave the flea and enter the skin puncture made by it. Because of the high percentage of infected fleas found under natural conditions, and because of the close association between dogs and fleas, fleas are probably the natural vectors of canine filariasis. It is apparent that the transmission of filariae is far less efficient than that of malaria parasites, where every bite results in a positive inoculation, so that the rate of infection of the intermediate host can be high and the rate in the definitive host low.

Audy (J. R.). Ed. **Malaysian Parasites I–XV.**—*Stud. Inst. med. Res. Malaya* no. 26, vii + 242 pp., 1 col. map, text illus. Kuala Lumpur, 1954.

This study is intended to be the first of a series that will gather together information relating to various groups of external and internal parasites of man and animals in the Malaysian region. It comprises 15 papers, of which five (by A. A. Sandosham) deal with helminths and one (by R. Traub) contains descriptions of two new fleas from field rats (*Rattus* spp.) in North Borneo.

One of the others, **Collections made in Malaya by the Colonial Office Scrub Typhus Research Unit,** by J. R. Audy & J. L. Harrison (pp. 1–22, 3 maps, 20 refs.) is mainly concerned with a collection of over 21,000 vertebrates made in Malaya between 1948 and 1952, in connection with research on the transmission of tsutsugamushi disease. The following is from the authors' summary. The collection comprised some 115 species of mammals, 30 of birds and 90 of reptiles and amphibians. The collecting areas and the methods of collection of the animals and of their external and internal parasites are described, and a brief account is given of the principal hosts and their ectoparasites. The distribution of the principal species of Trombiculid mites on these hosts is shown in some detail, and gross infestation figures are given for the major groups of ectoparasites. Brief accounts are also given of additional small collections from two localities on the mainland, from islands in the Malacca Straits, and from the Nicobar Islands.

The remaining papers comprise: **Species of** *Trombicula* **(Acarina Trombiculidae) from Borneo,** by R. Traub & Audy (pp. 45–76, 94 figs., 1 map, 7 refs.), in which eight new species are described from North Borneo, a means of differentiating *T. deliensis* Walch and *T. akamushi* (Brumpt) is given [*cf. R.A.E.*, B **41** 193] and these two species are redescribed in so far as is necessary for comparison with the new ones; **Species of** *Euschöngastia* **sensu lato (Acarina Trombiculidae) from Borneo,** by Traub & Audy (pp. 77–88, 53 figs., 5 refs.), in which six new species of *Euschöngastia* are described; **Indo-Malaysian Chiggers of the Subgenus** *Schöngastiella* [of the genus *Gahrliepia*] **(Acarina Trombiculidae),** by Traub & T. M. Evans (pp. 89–107, 76 figs., 10 refs.); **New Genera and Species, apparently of Apoloniinae (Acarina, Leeuwenhoekiidae), from the Asiatic-Pacific Region,** by H. Womersley (pp. 108–119, 5 figs., 3 refs.); **On the Validity of those Genera of Trombiculidae (Acarina) with posterolateral Setae off the Scutum,** by Womersley (pp. 120–122, 13 refs.); **Notes on the Taxonomy of Trombiculid Mites with Description of a new Subgenus** [*Helenicula* of *Euschöngastia*], by Audy (pp. 123–170, 3 figs., 54 refs.); and **Feeding Times of Trombiculid Larvae,** by Harrison (pp. 171–183, 5 figs., 9 refs.). The following is based on the author's summary of this last paper. An account is given of the estimation of the feeding times (periods of attachment to the host) of Trombiculid larvae by keeping infested rats and mice in small cages over trays of water and counting the larvae that detach each day. Estimates of the mean feeding time are needed to calculate actual populations of mites or to compare populations of different species on the basis of infestation data. Feeding times were recorded for laboratory bred mites fed on white mice, mites found on marked rats that had been trapped within two days of release, and mites found on trapped wild rats of unknown origin. The interpretation of results from the first two groups is straightforward. Two methods for making estimations from the observed data on mites of the third group, which have been on the rat for an unknown period before trapping, are discussed. These methods (mean mode and angular transformation) gave reasonably consistent results. Estimates of

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the mean, modal and maximum feeding times are given for 21 species (including *T. akamushi* and *T. deliensis*) and casual records for 15 more.

Martini (E.). **Wege der Seuchen . . .** [The Ways in which Epidemics Spread . . .]—3rd revd. edn., 9¾ × 6½ ins., vii + 203 pp., refs. Stuttgart, F. Enke Verlag, 1955. Price bound *DM.* 21.80; unbound *DM.* 19.

This edition of a work already noticed on the factors concerned in the production of epidemics of diseases of man [*R.A.E.*, B **25** 15] has been expanded, notably by the inclusion of a chapter on the spread of diseases that do not require the agency of a living vector or intermediate host and of further information on those that require an intermediate host but no living vector. Greater emphasis than before is laid on diseases that occur in Germany.

Wharton (D. R. A.), Miller (G. L.) & Wharton (M. L.). **The odorous Attractant of the American Cockroach,** *Periplaneta americana* **(L.). I. Quantitative Aspects of the Response to the Attractant.**—*J. gen. Physiol.* **37** no. 4 pp. 461–469, 4 figs., 6 refs. Baltimore, Md., 1954. **II. A Bioassay Method for the Attractant.**—*T. c.* pp. 471–481, 4 figs., 2 refs.

An account is given in the first part of this paper of the methods used and results obtained in quantitative studies of the response of males of *Periplaneta americana* (L.) to the scent of the attractant that is emitted by the females and adheres to surfaces with which they come in contact. The attractant was extracted with petroleum ether at room temperature from papers on which virgin females had been kept for about a week, and 15 mm. disks of filter paper that had been impregnated with 0·04 ml. of a solution of it and had dried were presented to the males. The males react to the impregnated disk in the same way as to the receptive female. Isolated males did not respond so readily as grouped ones. The percentage of males responding varied with the logarithm of the concentration of the attractant throughout a wide range. Successive exposure showed a cyclical alternation of excitement and rest. Two groups of males under simultaneous test showed similar patterns of cyclic response. Results would presumably become less reproducible as the number of cockroaches used decreased. For purposes of assay, groups of 70 appeared satisfactory. Adaptation to the olfactory stimulus was demonstrated, and a theoretical explanation of it is put forward.

The object of the work described in the second paper was to evolve an accurate method of assay for the attractant, to be used in connection with fractionation and purification studies. Three methods are considered, most attention being given to one referred to as the counterpoint test. This method involves the use of two matched groups of cockroaches for a simultaneous titration of standard and unknown, and enables results with a statistical error of ± 40 per cent. at a level of significance of 95 per cent. to be obtained. This level of error is considered acceptable for a method of assay of the attractant.

Williams (R. W.). **A Study of the Filth Flies in New York City—1953.**—*J. econ. Ent.* **47** no. 4 pp. 556–563, 16 refs. Menasha, Wis., 1954.

The relative abundance of different species of flies in a semi-business and residential area of New York City was determined by trapping

throughout the season (early May to the end of September) in 1953. The area contained numerous restaurants and fruit, vegetable and meat markets, and there was little breeding material other than that in garbage containers. Four traps were exposed from 9.15 a.m. to 3.15 p.m., usually for five days each week. Two were at ground level and two on a roof 85 ft. above it, and one of each pair was baited with raw fish and one with raw liver. The numbers of each species caught are shown, for each fortnight of the period, and information is also given for many on relative prevalence at ground and roof level, powers of flight and preference for fish or liver, with seasonal changes in this preference, which were sometimes significant.

The most abundant species was *Lucilia* (*Phaenicia*) *sericata* (Mg.), which comprised 9,684 of the 18,118 flies taken. Other flies of which over a thousand were trapped were *Phormia regina* (Mg.) (2,565), *Cynomyia* (*Cynomyopsis*) *cadaverina* R.-D. (1,687), *Sarcophaga* spp. (1,112) and *Calliphora vicina* R.-D. (1,041). Some 30 other species contributed to the total. *L. sericata*, *P. regina*, *Cynomyia cadaverina* and *Sarcophaga* spp. were the flies that Melnick found positive for poliomyelitis in a survey in Illinois [*R.A.E.*, B **40** 68–69] and (except for *P. regina* in September) they formed far higher percentages of the population in this study than at the corresponding season in Illinois. If flies are of any importance in the transmission of poliomyelitis, one of the factors that would affect the risk in New York City is whether they could acquire the virus without coming into direct contact with infected human faeces [*cf.* **30** 93].

Munson (S. C.), Padilla (G. M.) & Weissmann (M. L.). **Insect Lipids and Insecticidal Action.**—*J. econ. Ent.* **47** no. 4 pp. 578–587, 1 graph, 26 refs. Menasha, Wis., 1954.

The following is based on the authors' summary. The hypothesis that insect lipids affect the action of an insecticide such as DDT by competing for it with the site of toxic action [*R.A.E.*, B **42** 71] is discussed in the light of pertinent literature. It is shown to explain negative coefficients of toxic action with temperature [*cf.* **41** 140, etc.] as well as the preconditioning effects of different temperatures [**42** 71], and it clarifies the relation between the liposolubility and insecticidal action of compounds such as DDT analogues, several of which are highly liposoluble and have low-grade insecticidal properties. It may also throw light on the differences in resistance to a given insecticide of insects of different nutritional conditions, sexes and stages of development, and on seasonal, specific and possibly strain variations in resistance, though it does not account for all such variations.

The amounts of DDT and p,p′methoxy-DDT (methoxychlor) that remain in solution for about an hour in the total lipids of *Periplaneta americana* (L.) at different temperatures when supersaturated solutions are cooled were established and are shown on a graph; there was a steep rise for both compounds between 20 and 30°C. [68–86°F.], which is in accordance with the hypothesis, for it is generally at this critical range that negative temperature coefficients occur. When nymphs of *P. americana* were preconditioned at different temperatures and treated externally with chlordane, bromo-DDT and fluoro-DDT, their resistance varied in the same way as to DDT [**42** 71]; chlordane was more toxic and bromo-DDT and fluoro-DDT progressively less toxic than DDT. Although females were more resistant than males to the DDT analogues, there was no clear difference between sexes in resistance to chlordane. Adults of *Drosophila melanogaster* Mg. and *Oryzaephilus surinamensis* (L.) preconditioned at different temperatures also varied in their resistance to DDT applied externally, the mean survival

times at 23°C. [73·4°F.] being shorter for those preconditioned at 30°C. than for those preconditioned at 18°C. [64·4°F.] or 23°C. Chlordane, methoxy-DDT, fluoro-DDT and bromo-DDT showed negative coefficients of action with post-treatment temperature when tested against *Oryzaephilus*.

Ryckman (R. E.), Ames (C. T.), Lindt (C. C.) & Lee (R. D.). **Control of Plague Vectors on the California Ground Squirrel by Burrow Dusting with Insecticides and the seasonal Incidence of Fleas present.**—*J. econ. Ent.* **47** no. 4 pp. 604–607, 4 figs., 7 refs. Menasha, Wis., 1954.

In October 1952, dusts containing 2·5 per cent. heptachlor, 2·5 per cent. aldrin, 2 per cent. dieldrin or 5 per cent. DDT were applied at 30 gm. per burrow entrance to all burrows of California ground squirrels (*Citellus beecheyi*) in fenced fields in southern California for the control of fleas (*Echidnophaga gallinacea* (Westw.), *Hoplopsyllus anomalus* (Baker) and *Diamanus montanus* (Baker)). The results obtained in the first 35 days after treatment have already been noticed [*R.A.E.*, B **42** 35]. In this paper, flea populations in the four treated fields and one control field over a period of one year are surveyed. After 3–4 days, aldrin, dieldrin and heptachlor had reduced flea indices on the ground squirrels from 128, 318 and 111, respectively, to less than one per animal, and DDT had reduced the index from 258 to 107. The index in the control field remained steady at about 170. In November, the index in the control field fell to 99·6 and that in the DDT-treated field to 6·9. Flea populations reached their minimum in February. The flea index in the control field was 1·2 in that month and 60·8 in May, and it reached a maximum of 304·8 in July when the indices in the fields treated with heptachlor, aldrin, dieldrin and DDT were 4·3, 11·1, 23·2 and 242·5, respectively. By September, the indices in all treated fields were approaching that in the control or were substantially above the economic threshold. It is concluded that dieldrin, aldrin or heptachlor dusted into burrows over a large area may be expected to keep the flea population below the level of economic importance for up to nine months.

Keller (J. C.) & Chapman (H. C.). **The Toxicity of Phosphoric Acid Esters to Anopheline Larvae.**—*J. econ. Ent.* **47** no. 4 pp. 628–630. Menasha, Wis., 1954.

Of 274 phosphoric acid esters tested in the laboratory in suspensions from acetone solutions in distilled water against fourth-instar larvae of *Anopheles quadrimaculatus* Say, only 14 showed enough promise to warrant field testing. The results obtained with these 14 in the laboratory and in the field are given in this paper. The lowest of the concentrations that gave 100 per cent. kill in the laboratory were, in parts per million, 0·0025 for sulfotepp [tetraethyl dithionopyrophosphate], 0·005 for parathion, EPN [ethyl p-nitrophenyl thionobenzenephosphonate] and methyl parathion, 0·01 for DDT (the standard of comparison), ethyl o-nitrophenyl thionobenzenephosphonate and Diazinon (O,O-diethyl O-2-isopropyl-4-methyl-6-pyrimidinyl thiophosphate), 0·025 for O,O-dimethyl O-2-chloro-4-nitrophenyl thiophosphate, paraoxon and O,O-dimethyl O-3-chloro-4-methyl-7-coumarinyl thiophosphate, 0·05 for malathion and chlorthion (O,O-dimethyl O-3-chloro-4-nitrophenyl thiophosphate), and 0·1 for Potasan (O,O-diethyl O-4-methyl-7-coumarinyl thiophosphate) and O,O-diethyl O-piperonyl thiophosphate. NPD (tetra-n-propyl dithionopyrophosphate) gave only 94 per cent. kill at 0·1 p.p.m., the highest concentration tested.

In field tests with the compounds sprayed in emulsions against larvae of *A. crucians* Wied. and *A. quadrimaculatus*, EPN, O,O-dimethyl O-3-chloro-4-methyl-7-coumarinyl thiophosphate, parathion and DDT reduced infestation by 92–96, 91–99, 88–99 and 95–99 per cent. at rates ranging from 0·0025 to 0·025 lb. per acre, and the others were less effective; sulfotepp, malathion and Potasan failed to give 90 per cent. kill even at 0·1 lb. per acre.

Wingo (C. W.). **House Fly Control with Diazinon.**—*J. econ. Ent.* **47** no. 4 pp. 632–635, 2 figs., 2 refs. Menasha, Wis., 1954.

The following is mainly based on the author's summary. Preliminary tests indicated that Diazinon [O,O-diethyl O-2-isopropyl-4-methyl-6-pyrimidinyl thiophosphate] at as low a rate as 5 mg. per kg. breeding medium will prevent development of larvae of the house-fly [*Musca domestica* L.] from freshly laid eggs. It was also found that 1 mg. Diazinon per gm. medium prevented normal pupation of last-instar larvae and emergence of adult flies. In laboratory tests, adults were knocked down by exposure for five minutes to fresh deposits of Diazinon at 45, 90 and 180 mg. per sq. ft. and none recovered. Field tests carried out in a cattle barn in Missouri where populations were heavy and sanitation was poor showed that a single application of Diazinon at 1 per cent. left a deposit that controlled house-flies for 35 days. No evidence of resistance to Diazinon was found in a population tested after continuous exposure to treated surfaces in the field for 97 days. A substantial kill of stable flies [*Stomoxys calcitrans* (L.)] occurred for 18 days after the application of the Diazinon sprays. Both heat and direct sunlight were found materially to reduce the knockdown effect and toxicity of Diazinon deposits. This confirms field observations that treated surfaces exposed directly to the sun during the day may become ineffective sooner than treated surfaces within a building.

Incho (H. H.) & Ault (A. K.). **The Toxicity to House Flies of Allethrin Analogs in Combination with Piperonyl Butoxide Analogs.**—*J. econ. Ent.* **47** no. 4 pp. 664–672, 4 figs., 10 refs. Menasha, Wis., 1954.

The following is almost entirely based on the authors' summary. The thenyl and benzyl analogues of allethrin and the furfuryl analogue (furethrin) [*cf. R.A.E.*, B **41** 47] were tested on *Musca domestica* L. by the turntable method [**26** 246] to determine their effectiveness in oil-base sprays when used alone or in combination with piperonyl butoxide and each of seven of its analogues. The graphic formulae of the substituted cyclopentenolones from which the allethrin analogues were prepared, and those of the analogues of piperonyl butoxide, all of which were methylenedioxyphenyl derivatives, are given. Allethrin alone and combinations of allethrin with piperonyl butoxide or its respective analogues were included as the standards. The three allethrin analogues, when tested alone, were less effective than allethrin alone. However, in combination with piperonyl butoxide and six of its seven analogues, the furfuryl and thenyl analogues were generally equal to or more effective than allethrin with the same synergist. The benzyl analogue showed lower activity than the other two when tested alone or in combination with the same synergists.

Hoffman (R. A.). **Self-treatment Rubbing Devices for Louse Control on Cattle.**—*J. econ. Ent.* **47** no. 4 p. 701, 2 refs. Menasha, Wis., 1954.

As it is often impracticable to spray or dip cattle in winter for the control of lice, a rubbing device on the lines of those successfully used against

horn flies [*Siphona irritans* (L.)] [*R.A.E.*, B **40** 131; **42** 188] was tested in Oregon in 1952–53 on nine herds infested with *Damalinia* (*Bovicola*) *bovis* (L.) and *Linognathus vituli* (L.). Twisted strands of barbed wire covered with burlap treated with 5 per cent. chlordane in oil were attached to a central pole at a height of about 5 ft. and stretched taut to two points near the ground about 9 ft. away in opposite directions. This allowed the cattle a choice of height to rub various infested parts of the body and enabled them to apply pressure. The burlap was treated again after 30 days. Infestation was estimated by counting the lice in ten 1-inch squares on representative sites. Several animals in all the treated herds were examined 15 or 22–25 days after the installation of the devices, and it was estimated that infestation had fallen by 89–91 per cent. after 15 days (when none of the animals was completely free from lice) and by 96–100 per cent. after 22–25 days (when very few were infested at all). Observations were continued for 55 days, but no living lice were found after the 25th day. There was no reduction of infestation on two control herds.

Hoffman (R. A.) & Cohen (N. W.). **House Fly Control with residual Sprays of Organic Phosphorus Insecticides.**—*J. econ. Ent.* **47** no. 4 pp. 701–703, 1 ref. Menasha, Wis., 1954.

Field tests were carried out in dairy barns in the San Joaquin Valley of California on the control of *Musca domestica* L. with deposits of Diazinon [O,O-diethyl O-2-isopropyl-4-methyl-6-pyrimidinyl thiophosphate], Bayer 21/199 [O,O-diethyl O-3-chloro-4-methyl-7-coumarinyl thiophosphate], Bayer L 13/59 [dimethyl 2,2,2-trichloro-1-hydroxyethylphosphonate], chlorthion (O,O-dimethyl O-3-chloro-4-nitrophenyl thiophosphate), malathion and NPD (tetra-n-propyl dithionopyrophosphate). Wettable powders and emulsifiable concentrates were used according to availability, and some formulations included sugar as a bait and some included piperonyl butoxide or sulfoxide [1,2-methylenedioxy-4-(2-(octylsulphinyl)propyl)benzene] as a synergist. Diazinon alone at 50 or 100 mg. per sq. ft. gave over 90 per cent. mortality in all tests, but the effective period was short. Wettable powder formulations were better than those from emulsions after the second week, when the latter were largely ineffective. The addition of sugar to the sprays appeared to prolong the effectiveness of the deposits slightly but did not attract enough flies to improve control noticeably. Piperonyl butoxide increased the mortality of flies and duration of effectiveness at the dosages used but not enough to be considered of practical value. Combinations of sulfoxide and Diazinon showed no promise. Greater concentrations of piperonyl butoxide are not considered advisable, but further research with formulations of wettable powders might be of value. None of the other materials showed promise. Bayer 21/199 was inconsistent. Bayer L 13/59 with sugar, and malathion alone or with sugar gave high initial mortalities but were effective for only two days.

Smith (C. L.) & Richards (R.). **New Insecticides for Control of the Cattle Grub.**—*J. econ. Ent.* **47** no. 4 pp. 712–713. Menasha, Wis., 1954.

Dieldrin and five phosphorus compounds tested in Texas in 1953 in washes for the control of *Hypoderma lineatum* (Vill.) caused no symptoms of poisoning in the cattle to which they were applied. The washes were used at 2 U.S. pints per animal and were worked into the infested part of the back with a stiff brush. Washes containing Diazinon [O,O-diethyl O-2-isopropyl-4-methyl-6-pyrimidinyl thiophosphate], Bayer 21/199 [O,O-diethyl

O-3-chloro-4-methyl-7-coumarinyl thionophosphate], malathion and dieldrin were prepared from wettable-powder formulations, a wash containing EPN [ethyl p-nitrophenyl thionobenzenephosphonate] from an emulsifiable concentrate and washes containing Bayer L 13/59 [dimethyl 2,2,2-trichloro-1-hydroxyethylphosphonate] as aqueous solutions. Malathion at 1 per cent., EPN at 0·1 per cent. and dieldrin at 0·5 per cent. killed only 5·6, 16·3 and 25 per cent. of the larvae in the initial test and so were not tried further. Diazinon at 0·5 per cent. and Bayer 21/199 and Bayer L 13/59 at 1 per cent., the highest concentrations tested, gave 91·7, 100 and 88·2 per cent. kill, respectively. This degree of control is similar to the 90–100 per cent. that is consistently obtained with a wash of derris or cubé containing about 5 per cent. rotenone.

Proceedings of the Jubilee Meeting [of the Association of Applied Biologists] **held in London 13–17 September 1954.**—*Ann. appl. Biol.* **42** pp. 1–414, 8 pls., text illus., refs. London, 1955.

Among the 38 papers read at this meeting and here printed in full, most of those that contain information on insect pests or on insecticides are noticed elsewhere [*R.A.E.*, A **43** 254]. Two are of veterinary interest. One of these is **Insects of Veterinary Importance and Colonial Development** (pp. 185–189), by J. Carmichael, which contains a list of some of the tick-borne diseases of cattle, sheep, horses and dogs in Africa with their vectors, and notes on the control of ticks and *Glossina* and chemoprophylaxis of trypanosomiasis. It is shorter than a similar one already noticed [B **42** 203], but contains a little additional information on the control of *Glossina* by means other than insecticides.

The other is **The Natural History of Sheep Blowflies in Britain** (pp. 197–207, 3 figs., 25 refs.), by J. B. Cragg, in which the breeding habits of sheep blowflies in Britain are discussed with reference to the literature and to certain unpublished observations. It has been shown that *Lucilia sericata* (Mg.) is the chief species concerned [*R.A.E.*, B **31** 150]. Samples of wool taken during dressing have yielded over 1,000 *L. sericata* from individual sheep. Observations in Wales on the blowflies developing from sheep carcasses showed that only carcasses of sheep infested with *L. sericata* before death produced a preponderance of this species. It rarely formed more than 10 per cent. of the flies emerging from other carcasses. If an infested sheep dies, larval activity maintains the carcass temperatures at more than 40°C. [104°F.] for 5–8 days when abundant food is available, so that eggs present (mainly *L. sericata*) hatch rapidly and the larvae are full-fed before competitors become established in numbers. The body temperature of a carcass that is not infested at death falls, and post-mortem changes occur before larvae appear. Hatching and growth take place slowly, and 2–4 days elapse before any marked rise in temperature is recorded. There was no evidence that high temperatures were responsible for any marked degree of mortality [*cf.* **37** 45].

The predacious larvae of *Ophyra leucostoma* (Wied.) and *Hydrotaea* spp. pupated near a carcass, but larvae of *Lucilia* and *Calliphora* nearly always pupated some 12 ft. or more away. This limited the time during which the latter were exposed to attack by the predators. The burial of carcasses within 3–4 days of death can raise the yield of *L. sericata* to the level to be expected from a carcass infested before death by affording protection from competition, predators and parasites. It is not certain that heavily infested sheep or the carcasses of sheep are the chief source of *L. sericata*. In proportion to their bulk, carcasses of small animals give a higher yield

of *L. sericata* than do sheep carcasses not infested before death, but the total production of naturally occurring small carcasses in difficult to assess. *L. sericata* also breeds in vegetable matter [**39** 206]. The extent to which it breeds in dung is uncertain.

Hobson suggested that a living-sheep factor and a putrefactive factor were necessary to provide the chemical stimuli that attract females of *L. sericata* to a sheep and induce them to oviposit on it [**25** 52, etc.]. Cragg & Ramage showed that the living sheep was not necessary [**33** 167], but it was later found that different results were obtained when attractants were exposed on sheep or used alone [**40** 182, 183]. Observations with an apparatus that reproduced some of the conditions associated with the exposure of attractants on sheep showed that one of the factors responsible for the difference was temperature. A degree of oviposition similar to that occurring on living sheep but not normally seen in traps was induced by exposing at 38–39°C. [100·4–102·2°F.] substances known to provoke oviposition on sheep. It was also observed that whereas *L. caesar* (L.), *L. illustris* (Mg.) and, to a smaller extent, *L. sericata* would all settle in response to the presence of sulphur-rich mixtures, *L. sericata* would oviposit if ammonium carbonate was present also, whereas the other species rarely did so. The presence of sheep wool was an important part of the mechanism of attraction. Laboratory experiments showed that females of *L. sericata* were particularly sensitive to some olfactory stimulus intimately associated with sheep wool and demonstrated differences in behaviour between different species of blowfly and between British, Australian and Danish strains of *L. sericata*. The studies supported the view that no clear-cut distinction can be drawn between supposed sheep and carrion strains of *L. sericata* [*cf.* **38** 124].

It has been shown that eggs are rarely laid on sheep at sites where temperatures exceed 34°C. [93·2°F.], as they are usually 2–4 cm. from the skin surface, and it is pointed out that, in considering humidity requirements, too much stress has been laid on requirements at 37°C. [98·6°F.] [**38** 122, etc.]. While the minimum humidity necessary for hatching does not vary markedly over the range of 25–38°C. [77–100·4°F.], the capacity of the eggs to develop is greatly affected. L. Davies [**38** 122] showed that at 30°C. [86°F.] and 25 per cent. relative humidity, a humidity well below the level normally recorded on sheep, some 68 per cent. of the eggs completed development, and larvae could withstand imprisonment in the egg for more than five hours at that temperature.

Dassanayake (W. L. P.). **The Control of Mosquito-breeding in Husk-pits by naturalistic Methods.**—*Ann. trop. Med. Parasit.* **48** no. 2 pp. 127–128, 1 pl. Liverpool, 1954.

The extraction of the fibre from coconut husks as a cottage industry in the coastal areas of southern and western Ceylon involves the soaking of the husks for several months in pits, and these pits serve as breeding places for very large numbers of mosquitos, particularly *Culex pipiens fatigans* Wied., the local vector of *Wuchereria bancrofti* [*cf. R.A.E.*, B **27** 177–178; **40** 8]. Control by larvicides is too costly and largely impracticable, but it was found that breeding in the pits could be reduced by making them on the edges of rivers so that they were covered by about an inch of freely moving water or on the sea shore where they were washed by every high tide. This provides a cheap method of control suited to the needs of individual households and eliminates the noxious smells associated with soaking the husks in stagnant water near dwellings.

Dassanayake (W. L. P.) & Chow (C. Y.). **The Control of** *Pistia stratiotes* **in Ceylon by Means of Herbicides.**—*Ann. trop. Med. Parasit.* **48** no. 2 pp. 129–134, 1 map, 6 refs. Liverpool, 1954.

The principal breeding-places in rural Ceylon of mosquitos of the genus *Mansonia*, the chief or sole vectors of *Wuchereria malayi* there, are reservoirs and marshes that contain heavy and perennial growth of *Pistia stratiotes*, and the areas in which *W. malayi* is endemic are clearly associated with them [*cf. R.A.E.*, B **27** 177–178]. The plant is perennial in some marshes and estuaries but persists for only 3–4 months of the year in others, as it is washed into the sea when the rivers are in flood. It is perennial in the reservoirs that contain water throughout the year, and seasonal in those in the driest areas, which do not. For several years, control was attempted by removal of the *Pistia* by hand every two months, but this proved expensive and unsatisfactory. Tests of chemical control were therefore made in which five weed-killers were compared as sprays. One of the two cheapest, most effective and easiest to handle and the only one available in large quantities was "Phenoxylene" 30, of which the active ingredient is the sodium salt of MCPA (4-chloro-2-methylphenoxyacetic acid). A spray containing 1–2 fl. oz. "Phenoxylene" 30 and 1 fl. oz. wetting agent (Teepol) per gal. water, applied at 36 gals. per acre, killed *Pistia* within 5–10 days, at about one-sixth the cost of manual removal. The use of this spray has consequently replaced manual removal throughout the endemic areas of Ceylon, and no ill effects to man, domestic animals, fish or prawns have been noticed. Treatment twice yearly is sufficient and should preferably be carried out before the rainy season and when the plants are young. Seeds are not killed by it.

Crosskey (R. W.). **Infection of** *Simulium damnosum* **with** *Onchocerca volvulus* **during the wet Season in Northern Nigeria.**—*Ann. trop. Med. Parasit.* **48** no. 2 pp. 152–159, 12 refs. Liverpool, 1954.

A description is given of the Kudaru area in Zaria Province, Northern Nigeria, where *Simulium damnosum* Theo. is present and *Onchocerca volvulus* was first recognised in 1951. Onchocercosis surveys carried out in 1952 and 1953 showed that there was a focus some 1,000 sq. miles in extent by the Galma River, and surveys for the microfilariae in the immediate neighbourhood of Kudaru showed 33–85 per cent. of the people examined to be positive. Of 1,680 females of *S. damnosum* taken by the river two miles from Kudaru during the rains of 1953 (June–October), 19·7 per cent. were infected with *O. volvulus* (11·6 per cent. with developing forms, 6·4 per cent. with infective forms and 1·7 per cent. with both infective and sausage forms). The ratio of developing to infective forms corresponded with expectation on the basis of the number of days spent in each stage and indicated that a higher mortality among parasitised than unparasitised flies is unlikely during the range of development studied. Developing larvae were found in the thorax only in most cases, but infective larvae were found in all parts and combinations of parts of the insect's body. Data are given on the maximum and minimum numbers of larvae found in the different body regions.

An attempt to relate weekly variations in the infection rate with weekly changes in the population density of *S. damnosum* (as estimated by the numbers biting per boy-hour) revealed little, if any, correlation. The percentage infected among females caught on the day after river flooding was only 8·5. This and the condition of many of the flies caught at this time indicated that the increased catches noticed after flooding [*cf. R.A.E.*,

B **42** 145] are due to recent emergences. Of 21, 55 and 24 females caught in woodland, 2½, 3½ and 4–7 miles from the breeding ground, 19, 20 and 20·8 per cent., respectively, were infected. This fails to indicate any change in infection rate with distance, but the numbers are too small for conclusions to be drawn. Parasites other than *O. volvulus* found in the flies included planidium larvae of an unidentified Chalcidoid similar to that figured by Lewis [**41** 38].

Mattingly (P. F.) & Chwatt (L. J. Bruce-). **Morphology and Bionomics of *Aëdes* (*Stegomyia*) *pseudoafricanus* Chwatt (Diptera, Culicidae), with some Notes on the Distribution of the Subgenus *Stegomyia* in Africa.** —*Ann. trop. Med. Parasit.* **48** no. 2 pp. 183–193, 4 figs., 20 refs. Liverpool, 1954.

Detailed descriptions are given of the larva, pupa and adult of *Aëdes pseudoafricanus* Chwatt [*R.A.E.*, B **38** 22], which is known only from the Lagos area of Nigeria, where it is sympatric with the closely related *A. africanus* (Theo.), and from the Banana peninsula in the Belgian Congo, where *A. africanus* is thought not to occur. The reason for the restriction of *A. pseudoafricanus* to coastal swamp areas is not clear, but it is possible that it cannot compete with *A. africanus* except near *Avicennia* mangrove. Its larvae were common in rot-holes in *Avicennia* trees near Lagos, whereas no larvae of *A. africanus* were found in the *Avicennia* zone. Of 510 adults (mainly females) of *A. pseudoafricanus* and 32 of *A. africanus* taken in coastal marshes and lagoon swamps in the Lagos area, 76·8 and 50 per cent., respectively, were collected at ground level and 23·2 and 50 per cent. on a platform 27 ft. above ground, near the top of the only tall tree in the area. Males of both species were taken at both levels. The peak of the mean absolute biting curve of *A. pseudoafricanus* fell between 6 and 8 p.m. (local mean time) when over 35 and 40 per cent. of the total numbers of the two species were collected.

Some recently acquired records of the distribution of mosquitos of the subgenus *Stegomyia* in Africa [*cf.* **40** 153; **41** 146] are appended.

Nicholas (W. L.) & Kershaw (W. E.). **Studies on the Intake of Microfilariae by their Insect Vectors, their Survival, and their Effect on the Survival of their Vectors. III. The Intake of the Microfilariae of *Acanthocheilonema perstans* by *Culicoides austeni* and *C. grahamii*.** —*Ann. trop. Med. Parasit.* **48** no. 2 pp. 201–206, 13 refs. Liverpool, 1954.

The finding at Kumba that many females of *Culicoides austeni* C., I. & M. and hardly any of *C. grahamii* Aust., become infected with larvae of *Acanthocheilonema perstans* after feeding on a person whose blood contains the microfilariae [*R.A.E.*, B **42** 103] might be explained by a lower intake of microfilariae by *C. grahamii* or to lower survival in it. This paper, which is the third of a series [*cf.* **43** 73, etc.], contains an account of an experiment in which the numbers of microfilariae taken in by groups of both species were compared with the numbers expected to be taken in, as computed from the concentration of the microfilariae in the peripheral blood of the host and from an estimate of the average size of the blood-meal, based on linear measurements of the distended mid-gut. Five groups of *C. austeni*, totalling 86 females, took in 76 microfilariae as compared with an expected 46, and a group of 35 females of *C. grahamii* took in three as

compared with an expected seven. It is concluded that the actual and expected intakes were of the same order in the two species, that the differences might have been due to errors in the estimation of the sizes of the blood-meals, and that the difference in the infection rates of the two species is due to a lower rate of survival of the larvae in *C. grahamii*. No ejection of clear fluid by either species during feeding was observed [*cf.* **42** 165].

Crewe (W.). **Studies on Ethiopian *Chrysops* as possible Vectors of Loiasis. I. *Chrysops langi* Bequaert.**—*Ann. trop. Med. Parasit.* **48** no. 2 pp. 216–219, 8 refs. Liverpool, 1954.

Adults of several species of *Chrysops*, including some not previously known to occur in the area, have been bred from larvae and pupae collected at Kumba in the British Cameroons. The larvae were obtained by sieving mud from the bed of a stream and kept individually in small porous pots containing sieved mud from the breeding site. Each pot was placed in a jar containing a little water, which prevented the mud from drying. The flies reared included six females of *C. langi* Beq. Five were fed on volunteers whose blood contained microfilariae of both *Loa loa* and *Acanthocheilonema perstans*, and four of them harboured infective filaria larvae 9–12 days later. The fifth was dissected seven days after the blood-meal and harboured immature larvae. The sixth female was fed on a volunteer whose blood contained microfilariae of *A. perstans* only, and no larvae were found in it a week later. It appeared, therefore, that the microfilariae of *L. loa* develop as well in *C. langi* as in *C. silacea* Aust. and *C. dimidiata* Wulp, the important vectors of loiasis in Nigeria and the Cameroons. Although about one-third of the adults of *Chrysops* bred at Kumba were *C. langi*, the only examples of this species that have been taken in nature as adults are those from which it was described, which had been the prey of a wasp (*Bembix*) at Stanleyville, three caught at Kumba in the forest canopy about 50 ft. above ground level [*R.A.E.*, B **41** 27] and one female from the French Cameroons. The species can thus be of little importance in the transmission of loiasis to man, but it may be the usual vector of the similar filarial parasites that occur in monkeys in the Kumba area. The experiment with it, and others with laboratory-reared females of *C. silacea*, *C. dimidiata*, *C. griseicollis* Beq. and *C. maxima* Kröber, have shown that all of them would take a blood-meal without having paired.

Halcrow (J. G.). **The Vectors of Filariasis in Mauritius.**—*Trans. R. Soc. trop. Med. Hyg.* **48** no. 5 pp. 411–413, 3 refs. London, 1954.

It is concluded from the results of recent dissections of mosquitos caught in nature that *Anopheles gambiae* Giles and *Culex pipiens fatigans* Wied. are vectors of bancroftian filariasis [*Wuchereria bancrofti*] in Mauritius, and that *A. coustani* Lav. and *A. maculipalpis* Giles are not [*cf. R.A.E.*, B **43** 62]. *A. maculipalpis* was never found to be infected and precipitin tests indicated that it feeds on cattle and not on man. Filariae in a state of arrested growth were common in *A. coustani* but proboscis infection was extremely rare. Filariae were found in 5·6 and 1 per cent. of 500 and 1,020 females of *A. gambiae* dissected in 1952 and 1953, respectively, and in 10·6, 2·1 and 0 per cent. of 832, 1,624 and 271 of *C. p. fatigans* dissected in 1952, 1953 and 1954. The *Culex* females dissected in 1954 were from

urban areas, but the reason why the rates of infection in both species were much lower in 1953 than in 1952 is not known. Proboscis infection was found in 8 of the 38 infected females of *A. gambiae* and in 27 of the 125 of *C. p. fatigans*. All mosquitos were dissected within 16 hours of collection.

C. p. fatigans is not abundant in country areas around the coast, where the incidence of filariasis is high, and *A. gambiae* is rarely found in the urban areas of the central plateau, where there is little filariasis. Both are most active during the 2–3 hours after sunset when the people are out of doors, so that they can obtain blood-meals without entering the treated houses. Later in the night, they feed on goats and dogs on the verandahs. Precipitin tests showed that *A. gambiae* is attracted to cattle about twice as readily as to man, whereas *C. p. fatigans* is attracted almost exclusively to man. This would greatly increase the potential importance of the relatively small populations of the latter in the rural areas. It is suggested that the low incidence of filariasis in urban areas, despite high populations of *C. p. fatigans*, is due primarily to the low reservoir of human infection, though higher standards of hygiene, nutrition, housing education and income may be additional factors.

Gillies (M. T.) & Shute (G. T.). **Environmental Influences and the maxillary Index in** *Anopheles gambiae*.—*Nature* **173** no. 4400 pp. 409–410, 2 refs. London, 1954.

Senior-White (R.). **Adult Anopheline Behaviour Patterns: a suggested Classification.**—*T. c.* no. 4407 p. 730, 1 ref.

Gillies (M. T.). **Biological Races of** *Anopheles gambiae*.—*Trans. R. Soc. trop. Med. Hyg.* **48** no. 5 pp. 443–445, 7 refs. London, 1954.

In the first paper, an account is given of laboratory experiments carried out in Tanganyika to examine Holstein's hypothesis that *Anopheles gambiae* Giles is divided into a paucidentate population with a maxillary index of about 13·5, which is anthropophilous, mainly exophilous and breeds in temporary pools, and a multidentate population (maxillary index about 15), which is zoophilous, endophilous and breeds in permanent types of water with a high organic content [*R.A.E.*, B **41** 115–116]. The conclusion that different kinds of females emerge from different kinds of breeding places is supported by Campbell's observations [**40** 41–42]. In the authors' experiments, individual egg batches were divided into two lots, and one lot was reared at 90°F. and the other at room temperature (about 70°F.). The eggs and larvae were reared in bowls measuring about 10 × 12 ins., and about 100–150 eggs were put in the hot bowls and 300–450 in the cool ones. The maxillary index of the parents was 14·5, that of the progeny reared in cool, crowded bowls 14·3 and that of progeny reared in hot, uncrowded bowls, 15·8. This showed that, unless adults are reared under standard conditions, no valid comparisons can be made of the maxillary indices of populations derived from different localities or breeding sites.

In the second paper, Senior-White draws up lists of some of the principal malaria vectors that are, respectively, endophagous (tending to feed in a man-made structure, whether dwelling or animal-shelter) and exophagous (seeking a blood-meal out of doors) and subdivides each into those that are endophilous (remaining within a man-made shelter throughout the whole or a definite part of the gonotrophic cycle) and those that are exophilous (going through most of the gonotrophic cycle out of doors). Following Holstein, he classes the latter's zoophilous race of *A. gambiae* as endophagous and

endophilous and the anthropophilous race as endophagous and exophilous. The only exophagous species that is endophilous is *A. pseudopunctipennis* Theo. as observed by Downs in Mexico [*cf.* **41** 88].

In the third paper, Gillies reviews the contents of the first two as they relate to *A. gambiae*, cites data from Holstein's own work that do not support the latter's conclusions, and describes recent work in Tanganyika, mainly by C. D. Ramsdale, in which the unreliable nature of observations on the correlation of feeding habits with maxillary indices in uncontrolled populations was demonstrated. Females of *A. gambiae* from house catches at Muheza, 25 miles from the coast, had a maxillary index of 14·7. They fed almost entirely on man, as there were virtually no cattle in the district. At Kihurio, 70 miles to the north-west, the maxillary index of house-caught mosquitos was 15·7 and large numbers of females were shown by precipitin tests and bait catches to be biting cattle. This appeared to be evidence of the presence in some numbers of a zoophilous, multidentate race inland and of a purely anthropophilous, paucidentate race nearer the coast. However, when eggs from females caught at Kihurio were reared under crowded and much cooler conditions, the maxillary index of the progeny was only 13·9. Moreover, both man-biting and cattle-biting females at Kihurio had an index of 15·7. The occurrence of multidentate adults at Kihurio is attributed to the presence of large permanent swamps rich in organic matter and aquatic life and that of paucidentate adults at Muheza to the fact that breeding places there are more temporary or take the form of wells.

Suyemoto (W.), Scanlon (J. E.) & Sicay (T. C.). **Ectoparasite Fauna of small Mammals and Birds in the Fuji Maneuver Area, Honshu, Japan.** —*J. Parasit.* **40** no. 6 pp. 632–637, 10 refs. Lancaster, Pa., 1954.

The authors record and discuss some of the principal results of eight surveys, made in 1952 and 1953, of the ectoparasites of the rodents, insectivores and birds in small areas on a part of the north-east slope of Mount Fuji that is roughly the same as that surveyed by Kuwata, Berge & Philip in 1948 [*R.A.E.*, B **40** 16]. Particular attention was given to the seasonal distribution and abundance of Trombiculid larvae, in an attempt to determine the probable vectors concerned in the outbreak of tsutsugamushi disease (scrub typhus) that occurred among troops in the neighbourhood in the autumn of 1948 [*loc. cit.*]. Most of the 16 species taken (which belonged to four genera) were scarce or absent in summer; their numbers rose rapidly in September with the advent of cooler weather and heavy rain. The average number of individuals per host on the four most abundant rodents and the one common insectivore was 9·03. The species considered as possible vectors of tsutsugamushi disease, because they belong to the subgenus *Leptotrombidium* of *Trombicula*, were *T. kitasatoi* Fukuzumi & Obata [*cf.* **42** 50], *T. fuji* Kuwata et al., *T. palpalis* Nagayo et al., *T. pallida* Nagayo et al. and *T. scutellaris* Nagayo et al. None of these was found in August, and *T. pallida* and *T. scutellaris* were the only ones plentiful enough in September and October to be likely to have been concerned in the 1948 outbreak. The distribution of these Trombiculids was sporadic, so that no particular kind of area could be recognised as particularly dangerous, and protection from Trombiculid-borne disease would appear to depend on the use of clothing treated with acaricides and avoidance of intimate contact with infested ground.

Notes are given on the lice, fleas and other mites taken, none of which is believed to be concerned in the transmission of human disease in Japan.

Sikes (R. K.) & Chamberlain (R. W.). **Laboratory Observations on three Species of Bird Mites.**—*J. Parasit.* **40** no. 6 pp. 691–697, 6 refs. Lancaster, Pa., 1954.

An account is given of three years' observations under controlled conditions on laboratory colonies of *Bdellonyssus bursa* (Berl.), *Fonsecaonyssus* (*B.*) *sylviarum* (C. & F.) and *Dermanyssus gallinae* (Deg.), reared by methods that have been described [*R.A.E.*, B **40** 70]. *F. sylviarum* and *B. bursa* fed readily on chicks either in the dark or in half-light. The initial meals of both protonymphs and adult females were usually incomplete, but a full meal was necessary for moulting or oviposition. *B. bursa* oviposited in the litter, but *F. sylviarum* oviposited almost always on the host unless the mite population was extremely large. *D. gallinae* fed best in the dark, and the feeding stages (protonymphs, deutonymphs and adult females) usually engorged completely at the first opportunity. The females then sought hiding places, in which they remained for about three days and oviposited. After ovipositing, they fed again as soon as a host was made available. Deutonymphs of *B. bursa* and *F. sylviarum* and larvae of all three species did not feed. The life-cycle from adult feeding to the emergence of second-generation adults could be accomplished in 8–9 days in *D. gallinae* and 5–7 days in the other two species, though more time was needed by the latter if delays occurred in protonymphal feedings. Data are given on the duration of individual stages, the average measurements and weights of the different stages of the three species are shown in a table, and the sizes of blood-meals are estimated. Under experimental conditions, all three species fed readily on mice and rabbits as well as on chicks, but the percentage of females ovipositing and average number of eggs per ovipositing female were generally lower after a feed on mammalian blood. Only 5 per cent. of females of *D. gallinae* and none of the other species could be induced to feed on man, and the few eggs laid by the females of *D. gallinae* did not hatch.

Schiller (E. L.), McIntyre (J. C.) & Shirbroun (R. E.). **Preliminary Observations on an experimental Treatment for Demodectic Mange in Dogs.**—*J. Parasit.* **40** no. 6 pp. 704–706. Lancaster, Pa., 1954.

An ointment consisting of 4 parts β-naphthol, 8 parts sublimed sulphur, 30 parts Balsam of Peru and 30 parts petroleum jelly, which had been reported to be effective against facial dermatitis caused by *Demodex folliculorum* (Simon) in man, was tested in Alaska in 1950 on dogs suffering from mange caused by *D. canis* Leydig. It was so effective that it was then used for routine treatment at two laboratories there, and 57 dogs were freed from the mange by 1–6 weekly applications. The ointment was rubbed into the skin of the affected area, which was first washed with soap and warm water.

Feldman-Muhsam (B.). *Rhipicephalus bursa* **in Israel.**—*Bull. Res. Coun. Israel* **3** no. 3 pp. 201–206, 8 figs., 16 refs. Jerusalem, 1953.

Descriptions are given of the larva, nymph and adults of both sexes of *Rhipicephalus bursa* C. & F., which comprised about 1 per cent. of some 2,800 adults of species of *Rhipicephalus* examined from different hosts in Israel. The main hosts of the larvae and nymphs as well as of the adults were sheep and goats, although Russian workers found that the larvae and nymphs did not feed on sheep [*R.A.E.*, B **23** 1–2; *cf.* also **23** 6]. Immature stages and adults were also taken on cattle and mules. Larvae and nymphs were found feeding in the external ear canal of sheep and goats from December to March. The few adults collected were taken in May and June, except for one engorged female found in October on a mule.

Wolfinsohn (M.). **The Rearing, Marking and Trapping of Houseflies (*Musca domestica vicina*) for dispersal Studies.**—*Bull. Res. Coun. Israel* **3** no. 3 pp. 263–264, 1 fig., 6 refs. Jerusalem, 1953.

Simple methods devised in Israel for studies involving the release and recapture of marked house-flies are described. The flies (*Musca domestica vicina* Macq.) were reared in a sloping container so that they pupated in the upper (drier) part of the medium [*cf. R.A.E.*, B **41** 199], and this was transferred to a wooden box with a hole in its lid, through which the emerging flies passed into a gauze trap. To mark the flies, they were fed two days before release on a mixture of equal parts of sugar and finely divided ferric oxide, with the result that the abdomens became red and remained so for several days, permitting of easy identification. The traps used for recapture were lined with adhesive paper to which the flies stuck and against which marked individuals could easily be seen and counted. Upright and inverted traps were used, each consisting of a jar with a wire-gauze cone entrance in the mouth. In the upright type, the bait was put in the jar. In the other, the jar was inverted on a stand over a beaker containing the bait, and a cylinder of black paper was fitted around the lower end so as to project beyond the upper edge of the beaker with a space for the flies to reach the bait. The best bait was one composed of 5 per cent. baker's yeast in water, previously kept for a week at room temperature in a closed container.

In a typical experiment, 26 upright and 21 inverted traps were set in circles at distances of 55–330 yards round a point at which 50,000 marked flies were released. Two days later, 6,898 (14 per cent.) of the flies were in the traps among a catch of nearly 140,000. The average numbers of marked flies recovered per trap at distances of 55, 110, 220 and 330 yards from the point of release were 572, 190, 48 and 29, the numbers of traps on the circles at these distances being 4, 9, 16 and 14. Inverted and upright traps in similar positions caught averages of 64·6 and 35 flies each. Flies dispersed in every direction in spite of a prevailing north-west wind blowing at 5–10 miles an hour, but more went with the wind than against it.

Davidson (G.). **The Principles and Practice of the Use of Residual Contact Insecticides for the Control of Insects of medical Importance.**—*J. trop. Med. Hyg.* **58** nos. 3–4 pp. 49–56, 73–80, 12 refs. London, 1955.

The following is virtually the author's summary. The main principles involved in the practical application of DDT, BHC and dieldrin as residual contact insecticides for the control of insect pests of medical importance are discussed. The availability of the insecticide to the insect, and hence its toxicity and persistence, depend on the physical form in which it is applied and on the type of surface treated. The most efficient formulation is one that leaves the insecticide on the particular type of surface in a form readily picked off by insects alighting on or walking over it. The use of solutions, emulsions and wettable powders for the residual spraying of buildings and the technique of applying them are described, as well as the characteristics and uses of numerous other formulations such as dusts, aerosols and larvicides. The principles of the control of diseases transmitted by adult insects that act as true intermediate hosts of the causal organisms are discussed. Disease transmission can be intercepted without very high mortalities being necessary among the insect hosts. The problem of resistance to insecticides is briefly referred to. Detailed methods for the control of specific insect pests of medical importance by one or other of the three insecticides are given.

Russell (P. F.). **Man's Mastery of Malaria.**—$8\frac{3}{4} \times 5\frac{1}{2}$ ins., xv + 308 pp., col. frontis., 24 pls., 26 pp. refs. London, G. Cumberlege, Oxford Univ. Press, 1955. Price £1 5*s*.

This book comprises the text of the series of Heath-Clark Lectures delivered in 1953 at the London School of Hygiene and Tropical Medicine and, in compliance with the terms of the Heath-Clark bequest, includes discussion of the educational, cultural and humanistic aspects of the development of knowledge on the etiology of malaria and its mastery. Etiology is dealt with in the first section, which includes chapters on early speculative theories and on the discovery of the causal *Plasmodium* and of the part played by Anophelines as vectors, and one on latent plasmodia in the vertebrate host and the discovery of tissue forms, culminating in the demonstration of pre-erythrocytic stages in the liver and of the persistence of this exoerythrocytic infection after the establishment of infection in the red blood cells. A very brief outline of the development of knowledge on the members of the complex of *Anopheles maculipennis* Mg. is included in the chapter on mosquitos.

The second section concerns treatment. The third on prophylaxis, comprises chapters on drainage, drugs, larvicides, the use of repellents, bed nets and contact or deposit sprays against the adult mosquitos, the achievements of various countries through the use of DDT, recession of malaria in the United States and in Europe, and the development of resistance to insecticides by mosquitos. The fourth section contains information on the international organisations that have contributed to malaria control work and the anti-malaria activities of the Rockefeller Foundation, and the fifth and last is a discussion of the effect of malaria prophylaxis on population pressure.

Smith (L. B.). **Bromeliad Malaria.**—*Rep. Smithson. Instn 1952* (Publ. 4125) pp. 385–398, 2 pls., 2 figs., 20 refs. Washington, D. C., 1953.

The history of the discovery of the transmission of malaria by species of the subgenus *Kerteszia* of *Anopheles* that breed in water held by bromeliads is briefly reviewed, and accounts are given of the measures taken for the control of this type of malaria in the two regions in which it occurred, Trinidad [*R.A.E.*, B **37** 42] and southern Brazil [**41** 56–57, etc.]. In Brazil, the main measures used were manual removal of bromeliads, deforestation and spraying of interiors of houses with DDT. Data are given on new and total cases of malaria occurring in each of the years 1944–51 in five municipalities of Santa Catarina, in each of which one of these measures or a combination of them was used. The object of deforestation was to protect the city or town by destroying breeding places as far as the crest of the nearest ridge or occasionally that of the second, if it was considerably higher. It generally took three years to complete, but the incidence of malaria dropped sharply by the end of the first year, and eventually the disease was virtually eliminated from the cities. In Brusque, where deforestation was used alone, total cases of malaria fell from 2,011 in 1945 to 18 in 1951. Deforestation had the advantage of being permanent, but initial loss was caused to landowners as urgency prevented the proper lumbering of much of the wood. Eventually, if the gentler slopes are used for pasture or vegetable culture and the others for growing *Mimosa*, which can be cut for firewood before bromeliads can become established, or *Eucalyptus*, on which they have difficulty in establishing themselves, the land can be turned to greater profit than the original forest. To protect rural areas, for which deforestation is not practicable, DDT and drug treatment of the parasite in man were used. A brief account is given of research, concentrated principally on the bromeliads, that has been in progress since 1949 with a view to increasing further the effectiveness of control.

HAFEZ (M.). **On the Behavior and sensory Physiology of the House-fly Larva, *Musca domestica* L. II. Prepupating Stage.**—*J. exp. Zool.* **124** no. 2 pp. 199–225, 11 figs., 31 refs. Philadelphia, Pa., 1953.

The following is based on the author's summary. The reactions to humidity, temperature and scent of third-instar larvae of *Musca domestica* L. that are ready to pupate were studied in a circular arena [*cf. R.A.E.*, B **40** 208], and the results are compared with those obtained with larvae of the same instar when they were feeding [*loc. cit.*]. The prepupating larvae prefer air with a relative humidity of about 50–60 per cent. and avoid moister air. At relative humidities above 75 or below 50 per cent., they are not sensitive to differences of relative humidity of the order of 17 or 25 per cent., greater differences being necessary to elicit a response. They generally show no adaptation to the humidity to which they have previously been exposed. The humidity receptors are probably the tufted thoracic sense organs previously described in the feeding larva [**40** 209]. Behaviour with regard to humidity seems to be controlled by differences of relative humidity and not of saturation deficiency.

The prepupating larvae are not sensitive to differences in temperature between 8 and 20°C. [46·4 and 68°F.] and appear to be more sensitive to temperatures above 20°C. than to those below 8°C. They strongly avoid temperatures above 22°C. [71·6°F.]. They generally show no adaptation to temperatures to which they have been previously exposed but show a certain degree of sensory adaptation to adverse temperatures. The orientation mechanisms that contribute to determine the reactions of the larvae to temperature and relative humidity are klinotaxis, klinokinesis and orthokinesis [*cf.* **40** 209]. The larvae have a weak sense of smell and seem much less able to distinguish between odours than are those that are still feeding. They show either a slight tendency to avoid the smells of acetic acid or dung or indifference to them. They do not show any response to the scent of ammonia.

TAYLOR (R. M.) & HURLBUT (H. S.). **The Isolation of Coxsackie-like Viruses from Mosquitoes.**—*J. Egypt. med. Ass.* **36** no. 9 pp. 489–494, 5 refs. Cairo, 1953.

HURLBUT (H. S.). **The experimental Transmission of a Coxsackie-like Virus by Mosquitoes.**—*T. c.* pp. 495–498, 2 refs.

It is recalled in the first paper that 19,239 mosquitos, collected about 20 miles to the north of Cairo and divided according to species into 300 pools, were examined for virus by intracerebral inoculation into suckling and young adult mice, and that the virus of West Nile encephalitis, which is pathogenic to adult mice, was isolated from seven pools [*R.A.E.*, B **43** 49]. A virus that produces overt symptoms and death in suckling mice but not in adult mice was isolated from five of the other pools, two composed of *Culex pipiens* L. and *C. univittatus* Theo., which were often pooled together as the adults are not readily distinguishable, one of *C. univittatus* alone, one of *C. antennatus* (Beck.), and one of several species including principally *C. antennatus*, *C. pipiens* and *C. univittatus*. The five strains of virus were all obtained from mosquitos caught in July and August, and all were re-isolated by a second inoculation of the original mosquito suspension.

A strain of the virus isolated from one of the mixed pools of *C. pipiens* and *C. univittatus* was used in the experiments described in the second paper. To begin them, females of *C. pipiens* were infected parenterally by thrusting a minute steel needle wet with the virus suspension through the wall of the thorax, and these mosquitos infected suckling mice on which they fed

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after an extrinsic incubation period of 1–2 weeks at about 30°C. [86°F.]. Uninfected females of *C. pipiens* and *C. univittatus* were fed on the mice thus infected, and both species transmitted the virus when fed on healthy suckling mice after 7–19 days. Propagation of the virus in *C. pipiens* was demonstrated by parenteral introduction and serial passage. After five serial passages, with cumulative dilutions totalling $10^{-9 \cdot 2}$, virus recovery exceeded the original concentration and mosquitos of the fifth passage transmitted the virus to suckling mice on which they fed.

These viruses were originally thought to belong to the Coxsackie group, but it is stated in addenda to the two papers that at least two of the strains, including the one used in the transmission experiments, have been found not to belong to this group.

HOCKING (B.). **Developments in the chemical Control of Black Flies (Diptera: Simuliidae).**—*Canad. J. agric. Sci.* **33** no. 6 pp. 572–578, 5 refs. Ottawa, 1953.

Further tests on the control of larvae and pupae of Simuliids (mainly *Simulium venustum* Say) were made in streams near Churchill, Manitoba, in 1951 and 1952 [*cf. R.A.E.*, B **38** 143; **39** 162]. The materials used were a solution of DDD, emulsified solutions of DDD, endrin and isodrin, a wettable-powder suspension of heptachlor, malathion applied as a suspension of a wettable powder and a diluted emulsifiable liquid, schradan as a formulation containing 63·3 per cent. technical octamethylpyrophosphoramide applied after diluting with water at 1:10, granules of 5 per cent. dieldrin in bentonite, and DDT in four forms. These were " sausages " prepared by soaking cheesecloth tubes stuffed with soft wood shavings in a solution of DDT in a 1:1 or 1:4 mixture of xylene and fuel oil and preventing evaporation of the solvent, similar " sausages " from which the solvent (xylene) had been allowed to evaporate, and " chuckers " or cakes of sawdust bound with a water-soluble wax and containing DDT in an emulsion concentrate. Formulations of schradan, dieldrin, heptachlor, malathion, endrin and isodrin were also tested against eggs and pupae of *S. venustum* in the laboratory. Application in the field was continued over a period of 15 minutes, so that the concentration in the water in parts per million can be ascertained by dividing the dosage in p.p.m.-minutes by 15. Control was designated excellent when no living larvae could be found after treatment in the observed length of stream.

The materials that gave this degree of control (with the insecticide dosages in p.p.m.-minutes in brackets after them) were the DDT " sausages " with the solvents retained (1·5), heptachlor (0·5) and dieldrin (6·5). Slight control or none was given by schradan (6), malathion in both forms (6), endrin (6), isodrin (3·3 and 4·6) and DDT " chuckers " (1·9). Intermediate results were given by the DDT " sausage " with solvent evaporated (2·8), DDD solution (1·5), DDD emulsified solution (6·4), DDT " chucker " (1·5), dieldrin (3) and heptachlor (0·15). The partial failure of the DDT " chuckers " was unexplained. None of the materials showed much promise against eggs or pupae.

It was found that some streams that had been heavily infested in 1947 and 1948 but drained an area over which DDT had been subsequently applied for mosquito control contained few Simuliid larvae in 1951 and 1952, while neighbouring streams that drained unsprayed areas contained many, and it was thought that the larvae were controlled by their continuous exposure to small amounts of DDT that reached the streams in surface drainage water. A hypothesis is advanced that, at least in permafrost areas, no special measures need be taken for the control of *Simulium* where DDT applications

for any purpose are made at a rate in pounds per acre per annum that exceeds 1·2 per cent. of the annual precipitation in inches. It is possible that a much smaller ratio of DDT to rainfall would be sufficient.

Nelson (W. A.) & Slen (S. B.). **Note on evaluating Populations of the Sheep Ked, *Melophagus ovinus* (L.) (Diptera: Hippoboscidae), on Feeder Lambs.**—*Canad. J. agric. Sci.* **33** no. 6 pp. 620–621, 2 refs. Ottawa, 1953. **Errata.**—*Op. cit.* **34** no. 3 p. 328.

Four methods of estimating populations of *Melophagus ovinus* (L.) on lambs were compared at Lethbridge, Alberta, with the "picked-off count" or actual population determined by picking off all the keds from each of the 39 animals. The methods were the "total live count" [*R.A.E.*, B **39** 200], in which all keds observed on parting the entire fleece are counted, the "5-minute count," in which all the keds observed by parting the fleece systematically from front to rear for 2·5 minutes on each side are counted, the "vertical-parting count" (with 4-inch spacings), in which a count is made of all the keds noted in fleece partings extending from mid-back to mid-belly on both sides, and finally the method described by Muma, Hill, Hixson & Harris [**41** 73]. The efficiency of each method was determined by correlation and regression analyses. The coefficients of correlation indicated a highly significant relationship between estimates for individual lambs by all four methods and the "picked-off count". The "total live count", although desirable in some circumstances, is unwieldy and impracticable when large numbers of animals are involved. The "5-minute count" is rapid but does not allow of completion of the count when the sheep is large or the infestation heavy. The "vertical-parting count" does not have this disadvantage and therefore should be applicable to mature sheep as well as to lambs. The standard errors of estimate were not significantly different and indicated that the accuracies of the four methods are of the same order.

Johnson (C. G.) & Taylor (L. R.). **The Development of large Suction Traps for airborne Insects.**—*Ann. appl. Biol.* **43** no. 1 pp. 51–62, 2 pls., 1 fig., 9 refs. London, 1955.

The following is the authors' summary. Small suction traps for estimating the density of airborne insects, and its fluctuations, in relatively sheltered situations, *e.g.*, in crops, have already been designed and used [*R.A.E.*, B **40** 29]. Larger, more powerful traps have now been developed for use in more exposed situations where insect densities are very low, or where winds are relatively strong, *e.g.*, high in the air. Because of the large sample obtained they also enable very short-term density fluctuations to be followed. The radical modifications of design and the special problems encountered in the operation of very large traps are described.

Hawkes (H. A.). **The Effects of Insecticide Treatment on the Macrofauna Populations, Film Accumulation and Efficiency of Sewage Percolating Filters.**—*Ann. appl. Biol.* **43** no. 1 pp. 122–133, 3 figs., 12 refs. London, 1955.

Various worms and insects are of value in sewage percolating filters because they graze on the bacterial and fungal film that develops on the stones [*R.A.E.*, B **34** 105, etc.], but only four species are ever abundant enough at the Minworth works near Birmingham to be considered effective

grazers. These are *Lumbricillus lineatus*, *Hypogastrura* (*Achorutes*) *subviatica* (Bagn.) [previously recorded as *H.* (*A.*) *viatica* (Tullb.) (**32** 140)], *Psychoda alternata* Say and *Anisopus fenestralis* (Scop.). The larvae of *Anisopus*, which is the dominant fly, are effective grazers, but the adults are a nuisance when they disperse from the works [**40** 29]. The effect of suppressing the population of *A. fenestralis* by insecticide treatment over a period of 15 months on the numbers of the other three species and on film accumulation and filter efficiency was examined between January 1951 and September 1953. BHC, added to the sewage as a water-dispersible powder [**40** 29], was applied at frequent intervals from March 1951 until June 1952 to about one acre of bed, and a similar area was left untreated for comparison. Previous work had shown that controlling *A. fenestralis* by a single application of BHC resulted in an increase in the film and so favoured the second generation [**40** 30]. Populations were assessed by examining unit volumes of stone excavated from the filters [**40** 140], except that a method involving flotation from the sample was evolved for the rough estimation of Collembola. Baited bags put just below the surface of the filters did not provide a satisfactory alternative method of estimating populations of the *Anisopus* larvae, as the catch tended to fluctuate inversely with the amount of available food and numbers of larvae in the filter.

The population of larvae and pupae of *A. fenestralis* was low at the beginning of the experiment, because the filters had been out of use and had dried out. The insecticide applied in March only partly suppressed the increase in populations that took place in spring and early summer, probably because of the large amount of film present, but numbers fell to nearly zero in both filters in June with the unloading of the film and remained very low in the treated one until applications were discontinued. Populations rose very rapidly in both areas in autumn 1952 and reached similar high peaks in the spring. *Lumbricillus* occurred in numbers in the control filter only after the seasonal summer decline in the *Anisopus* population, but was present throughout the year in the treated filter when the *Anisopus* population was suppressed. *Psychoda* and *Hypogastrura* also were more abundant in the treated than in the control filter during the treatment period. The film was more abundant in both filters in the colder than in the warmer months. Less film accumulated in the absence of *Anisopus* in the treated filter than in the control filter, and the discharge of solids was greater. This was probably due to the grazing activity of those organisms that had increased in numbers. Agencies other than the grazing of the insects and worms, such as bacterial decomposition of the fungal growths, also contributed to the discharge of the film. During the period of treatment, the treated filter was, in general, more efficient than the control one.

Bellemare (E. R.) & Belcourt (J.). **Toxicité pour la blatte américaine d'un nouvel analogue du DDT: 1,1,1-trichloro-2,2-bis-(p-cyanophényl)-éthane.**—*Canad. Ent.* **85** no. 12 pp. 449–453, 2 graphs, 7 refs. Ottawa, 1953.

The toxicity to adults of *Periplaneta americana* (L.) of 2,2-bis(p-cyanophenyl)-1,1,1-trichloroethane, which is referred to below as cyano-DDT, was compared with that of DDT by injections into the haemocoele by the method of Heal & Menusan [*R.A.E.*, A **37** 459]. The results are given in graphs, and these indicate that the median lethal doses of cyano-DDT and (in brackets) DDT in mg. per kg. insect weight were 54 (6·2) for males and 108 (15) for females. From the results of these experiments and similar ones with DDT and five other insecticides by Menusan [B **37** 188], the authors have calculated the toxicity indices as defined by Sun [A **38** 426] for the

seven insecticides. These showed that the order of toxicity for males of *P. americana* is pyrethrins>derris>DDT>cyano-DDT>nicotine>sodium fluoride>Lethane 384 [50 per cent. n-butyl carbitol thiocyanate in kerosene]. For females it is pyrethrins = derris>DDT>nicotine>sodium fluoride> cyano-DDT>Lethane 384.

Reeves (W. C.), French (E. L.), Marks (E. N.) & Kent (N. E.). **Murray Valley Encephalitis: a Survey of suspected Mosquito Vectors.**—*Amer. J. trop. Med. Hyg.* **3** no. 1 pp. 147–159, 2 figs., 18 refs. Baltimore, Md., 1954.

Attempts to isolate the virus of Murray Valley encephalitis from mosquitos could not be made during the course of the epidemic that occurred in the Murray Valley of Australia in January–March 1951 [*R.A.E.*, B **42** 15], and were unsuccessful when some 550 mosquitos of four species collected in the Shepparton area of Victoria in April 1951 were examined by French. As, however, the virus might have persisted in mosquitos or animal reservoirs after the epidemic had subsided, the authors undertook further studies in the summer of 1951–52 in a limited area of New South Wales and Victoria around Mildura, where cases had occurred and there had been serological evidence of extensive inapparent infection in man and animals in the previous summer. The area is described. Several thousand mosquitos of 16 species were caught in a great variety of natural and domestic environments and on human or animal bait, and tests were made with 433 pools comprising 17,833 females of the ten species of which more than 50 females were taken. Each pool consisted of not more than 100 females of one species. All were negative for MVE virus, though viruses of the bird pox type were isolated from *Culex* spp. and the virus of rabbit myxomatosis from *Anopheles annulipes* Wlk.

All the 16 species were taken on cows, 12 on man, six on horses, seven in fowl houses, 12 in natural shelters, ten in general domestic shelters and nine in miscellaneous collections. *Anopheles annulipes*, *Culex annulirostris* Skuse, *Mansonia linealis* (Skuse) and *Aëdes theobaldi* (Tayl.), of which 14,132, 19,075, 4,276 and 1,280 females were taken, respectively, were represented in all types of collections. Members of the group of *C. pipiens* L. [*cf.* **42** 113] (6,054 females probably mostly *C. p. fatigans* Wied. and *C. p. australicus* Dobrotworsky & Drummond [**42** 114]) were taken in all types of collection except those made on horse, and *A. vittiger* (Skuse) (1,165 females) in all except those on horse and in domestic shelters. No other species was represented by as many as 600 females.

It is concluded that the species likely to transmit MVE are, in order of declining importance, *C. annulirostris*, *C. p. fatigans* (or a related member of the complex), *M. linealis*, *Aëdes theobaldi* and possibly *Anopheles annulipes* [*cf.* **42** 15]. *C. annulirostris* and *C. p. fatigans* are experimental vectors of Japanese B encephalitis [**40** 86–87], and *C. p. fatigans* has transmitted the virus of St. Louis encephalitis and has been found naturally infected with it by Reeves (unpublished). Populations of *Aëdes* depend on flooding and are not stable from year to year. The study did not indicate that they would be of great importance. As no epidemiological evidence could be found that the virus was still present in the area studied, the negative findings do not disprove that mosquitos are vectors.

Larvae were collected in 62 sites of 13 types, and eleven species were found. *C. annulirostris* and *Anopheles annulipes* were taken in grassy and weedy pools and hoof-prints along the edges of the river and of waterholes, along the grassy or weedy edges of earthen drainage channels and in adjacent seepage pools, in flooded pastures and in shallow swamps formed by

irrigation drainage and in casual (sometimes slightly brackish) weedy pools. *A. annulipes* was also found in concrete drainage channels and certain artificial containers. *C. p. australicus* occurred in a very wide variety of breeding places. *C. p. fatiyans* and *C. globocoxitus* Dobrotworsky [**42** 113] were also taken occasionally, the former in man-made domestic breeding places and the latter once in a brackish pool and once in permanent water. Larvae of *Aëdes theobaldi* occurred in earthen drainage channels, flooded pastures, swamps and casual pools. Larvae of *M. lineatis* were not discovered, but are assumed to be associated with aquatic plants in swamps.

Dethier (V. G.). **Notes on the Biting Response of Tsetse Flies.**—*Amer. J. trop. Med. Hyg.* **3** no. 1 pp. 160–171, 38 refs. Baltimore, Md., 1954.

The biting responses of adults of *Glossina palpalis* (R.-D.), *G. morsitans* Westw. and *G. brevipalpis* Newst., attached by the wings to wax-tipped applicator sticks [*cf. R.A.E.*, B **41** 188] and subjected individually to various stimuli, were observed and compared with those of free-flying caged tsetses. The normal biting response includes characteristic movements of the mouth-parts, salivation and defecation. The reactions chosen as criteria for the adequacy of a stimulus were salivation (extrusion of a drop of salivary fluid), probing (depression of the entire mouth-parts) and piercing (disengaging of the haustellum). However, most attention was paid to the last two, as unfavourable as well as favourable stimuli led to salivation. Salivation resulted from contact with a paper-covered tube of water heated to temperatures of up to 70°C. [158°F.] and could be induced on a hot microscope slide. This provides a means of examining tsetses for trypanosomes and yet preserving them for transmission experiments [*cf.* **37** 137]. A warm surface was found to be the main stimulus to feeding in all three species, though contact of the feet with a substrate alone elicited some response, provided that the substrate was not too smooth to afford a foothold or otherwise repellent. It was not possible to determine the optimum temperature, which apparently lay between 34 and 45°C. [93·2 and 113°F.], but a paper-covered tube of water at 38°C. [100·4°F.] was slightly, though generally not significantly, more attractive than a finger.

Amputation showed the antennae to be the chief site of thermoreceptors calling forth the feeding response. Removal of palps did not reduce response. Neither odour nor contact of the tarsi with various substances provided an effective stimulus. As the tsetses became hungrier, they responded more readily, until the penultimate stages of starvation approached, when they became refractory. Repellent 622 (the 6:2:2 mixture of dimethyl phthalate, 2-ethyl-1,3-hexanediol and Indalone) applied to the shaven skin of a guineapig prevented feeding by caged free-flying tsetses for at least two hours, but fixed ones fed almost as readily in its presence as in its absence. They even probed and pierced when their feet were on the liquid. The mixture appears to act as an olfactory repellent.

Price (R. D.). **The Survival of *Bacterium tularense* in Lice and Louse Feces.**—*Amer. J. trop. Med. Hyg.* **3** no. 1 pp. 179–186, 9 refs. Baltimore, Md., 1954.

Observations on the persistence of the causal organism of tularaemia in *Pediculus humanus humanus* L. and its faeces were made with a rabbit-adapted strain of this louse [*R.A.E.*, B **39** 199]. The lice were fed through a membrane [*cf.* **40** 16] on a mixture of defibrinated rabbit blood and a suspension of a virulent strain of *Bacterium tularense*, and lice and faeces

were stored at 37, 29, 20 and 4°C. [98·6, 84·2, 68 and 39·2°F.] and at three different relative humidities (100, 50 and 0 per cent.) for each temperature. The faeces were collected during the first 24 hours following infection, and were stored at the temperature at which the lice had been kept, except that the faeces stored at 4°C. were produced at 20°C. Lice were either killed immediately after infection or allowed to starve to death. The presence or absence of infective bacteria in the lice or faeces was ascertained by mouse inoculation, and they were considered to have persisted until the mid-point between the last positive and first negative test, or until two days after the last positive test if there was no final negative test.

Temperature had a much greater influence on persistence of the bacteria than humidity or substrate; thus the average periods of persistence in days were, respectively: 4·55, 9·08, 18·66 and 33·05 at 37, 29, 20 and 4°C.; 10·18, 16·79 and 22·04 at relative humidities of 100, 50 and 0 per cent.; and 14·83, 15·52 and 18·67 in starved lice, killed lice and faeces. Statistical analysis showed that the effect of temperature was highly significant, and that the only other significant difference was in the humidity-substrate interaction. The main factor in this was undoubtedly the faeces-humidity interaction, persistence in faeces being shorter at the highest humidity and longer at the lower ones than in lice. The longest periods recorded were 53 days at both 50 and 0 per cent. humidity in faeces at 4°C., as compared with 38 and 45·5 days in starved and killed lice at the lowest temperature and humidity. Persistence in lice at 37°C. never exceeded 8·5 days.

To determine whether the louse was contributing anything, the persistence of the bacteria in blood on absorbent paper was tested. In this case, persistence was longest at saturated humidity at the two higher temperatures, and there was a tendency for the effects of humidity to be nullified at lower temperatures. Lice and especially louse faeces must have guarded the bacteria against at least complete desiccation at the higher temperatures. The greatest point of contrast was at 29°C. and 0 per cent. relative humidity, the bacteria persisting for 0·5 day on paper and 22·5 days in faeces.

Pimentel (D.) & Klock (J. W.). **Disinsectization of Aircraft by residual Deposits of Insecticides.**—*Amer. J. trop. Med. Hyg.* **3** no. 1 pp. 191–194, 3 refs. Baltimore, Md., 1954.

The tests described were carried out in passenger aircraft operating on routine schedules. Solutions of insecticides in methylcyclohexane (a solvent that does not damage Plexiglas or other aircraft materials) were applied with a paint sprayer to the inner surfaces, but pillows and slip covers in the passenger cabins were not treated, and the luggage compartments were loaded with untreated boxes. At intervals ranging up to eight weeks after treatment, mosquitos (*Aëdes aegypti* (L.)) and female house-flies (*Musca domestica* L.) were released in the treated compartments, recaptured after 45 or 90 minutes and kept for 24 hours to observe mortality. The criterion of effectiveness was 95 per cent. kill of the flies. The flies had inch-long nylon threads glued to the thorax to facilitate recapture and differentiate those used in separate tests.

The insecticide used in most of the tests was γ BHC as lindane, and a deposit of 200 mg. per sq. ft. was effective for five weeks in luggage compartments in all of 14 tests and gave 100 per cent. kill of flies and mosquitos for three and 5–7 weeks, respectively. The results were the same whether the aircraft had been treated in flight or on the ground, and whether the insects were exposed for 45 or 90 minutes, but they were not so good when Aroclor 5460 was added to the solution in an attempt to improve the deposit [*cf. R.A.E.*, B **41** 143]. Deposits of 50, 70 and 100 mg. lindane

per sq. ft. were used in the passenger cabins (because a heavier deposit causes objectionable spotting) and were effective for one, three and two weeks, respectively. Variations in uniformity of deposition, which was difficult to obtain with the low rates of application, may have been the reason why the intermediate deposit was the most effective; it was also the only one of the three that gave 100 per cent. kill of the mosquitos for five weeks.

The other insecticides used were DDT, at 200 mg. per sq. ft. in the luggage compartments of two aircraft, and dieldrin, at 100 mg. in the passenger cabin of one. The insects were exposed for 90 minutes. DDT gave only 75 per cent. kill of both flies and mosquitos in the first week and was less effective in subsequent ones; dieldrin gave 98, 97 and 92 per cent. kill of flies in the first, second and third weeks and was not tested against the mosquitos.

Grjebine (A.). **Observations sur les nématocères vulnérants de Madagascar: régions de Majunga et de La Mandraka.**—*Mém. Inst. sci. Madagascar* (E) **4** (1953) pp. 443–502, 31 figs., 20 refs. Tananarive-Tsimbazaza, 1954.

The results are given of mosquito surveys made in the regions of Majunga and La Mandraka, Madagascar, in 1951–52, and ten new species and two new varieties found there or at Anozibé are described in an appendix. Those of the genus *Anopheles* are *A. roubaudi*, sp. n., and *A. milloti*, sp. n., described from adults of both sexes, pupae and larvae, and *A. lacani*, sp. n., from a female, pupa and larva, all from La Mandraka, *A. ranci*, sp. n., described from a male, pupae and larvae from Anozibé, and *A. pauliani*, sp. n., from adults of both sexes, pupa and larva and *A. fuscicolor* var. *soalalaensis*, n., from a male, both from Majunga. The description of *A. milloti* is attributed to Grjebine & Lacan. Brief indications are given of the breeding place in all cases.

Both *A. gambiae* Giles and *A. funestus* Giles occur at Majunga, the former breeding among *Avicennia* mangrove and the latter in a stream at some distance from the town, but neither is plentiful and there is little malaria. Three females of *A. pauliani*, which appears to be widely distributed in the west of the island, were taken biting by day in forest. Larvae were found among floating tree roots in fairly deep, clear, very slowly moving water with a pH of 7·1 and among water plants and floating dead leaves. Larvae of *A. roubaudi* and a pupa of *A. mascarensis* De Meillon were found among floating vegetation on the edges of a clear, shaded, swiftly running stream. This is the first information available on the breeding places of the latter. Larvae of *A. milloti* and *A. lacani* were taken in seepage and marshy pools with short vegetation, and larvae of *A. ranci* were found among floating vegetation in swiftly flowing streams and rivers.

Lacan (A.). **L'anophélisme des plateaux de Madagascar en 1952.**—*Mém. Inst. sci. Madagascar* (E) **4** (1953) pp. 503–519, 17 refs. Tananarive-Tsimbazaza, 1954.

Changes in the composition of the Anopheline fauna of the plateaux of central Madagascar and in the behaviour of the adults since the publication of Monier's account of investigations in 1935–37 [*R.A.E.*, B **26** 207] are recorded in this paper. The species most widespread and numerous in 1952 were *Anopheles coustani* Lav., *A. squamosus* Theo. (with var. *cydippis* De Meillon), *A. gambiae* Giles, *A. marshalli* (Theo.) and *A. pharoensis* Theo., which comprised 37, 30, 14, 12 and 3 per cent. of the catch, respectively.

The others included *A. argenteolobatus* Gough, which had probably been recently introduced, as it was taken only near airfields. Several additional species, including *A. funestus* Giles, were found on the slopes of the plateaux but not on the plateaux themselves.

Anophelines were much less abundant on the plateaux than they had been in 1935–37, and the European population had to a great extent abandoned the use of bed nets. The most striking change in the species composition was the disappearance of *A. funestus*, which formerly comprised more than half the total, and the comparatively small numbers of *A. gambiae*.

The feeding and resting habits and seasonal distribution of the five most abundant species are discussed. The percentages of the females shown by precipitin tests to have fed on man and (in brackets) the maxillary indices were approximately 74 (12·5) for *A. squamosus*, 63 (16) for *A. coustani*, 58 (12) for *A. marshalli*, 54 (13·7) for *A. pharoensis* and 39 (13) for *A. gambiae*, which was present only during the hot, wet season and was more frequent in animal quarters than in dwellings. The changes in species composition and in the habits of *A. gambiae* are attributed to the DDT with which buildings have been treated twice yearly since November 1949 as an anti-malaria measure. Whereas the robust species, *A. coustani* and *A. squamosus*, withstood the effects of the DDT, although they frequent dwellings and feed on man on the plateaux, *A. funestus* was apparently eradicated by it and *A. gambiae* was driven to feed on animals and rest out-of-doors or in animal shelters, which are often untreated. The effects on the two chief vector species were accompanied by reduction in malaria and increase in population.

HAMON (J.). **Étude biologique et systématique des Culicidae de l'île de la Réunion.**—*Mém. Inst. sci. Madagascar* (E) **4** (1953) pp. 521–541, 12 figs., 12 refs. Tananarive-Tsimbazaza, 1954.

Anopheles coustani Lav., *A. gambiae* Giles and ten species of mosquitos of other genera were found on the island of Réunion during a survey that was begun in 1948 in connection with an anti-malaria campaign, lasted 21 months and took in almost all the inhabited regions and many uninhabited ones. Keys to the adults and larvae are given, as well as notes on the distribution of each species within the island and elsewhere, and on its habits and breeding places if known. *A. coustani* was one of the commonest mosquitos and was found throughout almost all of the coastal belt and also at altitudes of up to 3,300 ft. In the coastal districts, it bred in floating algae in rivers and in stagnant inlets or weedy streams and irrigation channels, pools, marshy fields and shallow wells, preferably in clear, fresh water. All the adults found near the coast were outside dwellings, but engorged females were sometimes taken in houses at an altitude of some 1,500 ft. Man was attacked avidly at dusk both indoors and out. *A. gambiae* was present in the coastal belt and on the lower slopes throughout the year, and up to considerable altitudes in some parts in the hot season. Its breeding places were very varied, but generally sunny and tepid. The females bit man in large numbers at dusk out-of-doors, and continued to attack, though with less intensity, during the night. They were frequently found engorged in houses before DDT treatment began, but were subsequently seen out-of-doors only. *Aëdes aegypti* (L.) nearly disappeared after the DDT treatment was instituted. The most widely distributed mosquitos were *A. albopictus* (Skuse) and *Culex pipiens fatigans* Wied. Synopses are given of the physical characteristics of the breeding places of the different species, their distribution by altitude and the species associations found in breeding places of various types.

Barr (A. R.). **Hybridization Experiments with some American dark-winged Anophelines.**—*Exp. Parasit.* **3** no. 5 pp. 445–457, 9 refs. New York, N. Y., 1954.

The results are given of extensive experiments on hybridisation between *Anopheles quadrimaculatus* Say, *A. freeborni* Aitken and *A. aztecus* Hffm., some of which have been noticed from a briefer account [*R.A.E.*, B **40** 127]. Large numbers of hybrid larvae were produced in the various crosses involving *A. quadrimaculatus* as one of the parents, but only two, both from *freeborni* females, survived to pupate. One of these died as a pupa; the other gave rise to a hybrid male that was shown to be fertile by back-crossing to *freeborni* females. As compared with homologous mating, all crosses resulted in reduced numbers of eggs and high mortality of eggs and larvae, but fertile F_1 females were obtained from the reciprocal crosses of *A. aztecus* and *A. freeborni*, and fertile F_1 males when the female parent was *freeborni*. When *aztecus* was the female parent, only a very small proportion of the progeny was male and no males survived long enough to be tested for fertility. Mortality of the pupae derived from crossing *aztecus* and *freeborni* was high, and many adults failed to emerge successfully [*cf.* **40** 187]. The various crosses showed great variability in numbers of eggs laid, numbers hatching and most advanced stage reached by the hybrids. The patterns of the hybrid eggs were similar to those of the females that laid them in the cases in which they were observed. The results of these experiments, like those of others [**41** 145; **43** 44], support the view that *aztecus* and *freeborni* are more closely related to each other than either is to *quadrimaculatus*, but are distinct species.

Jenkins (D. W.). **Parasitological Reviews. Advances in Medical Entomology using Radioisotopes.**—*Exp. Parasit.* **3** no. 5 pp. 474–490, 66 refs. New York, N.Y., 1954.

The subjects of this review of recent progress in techniques of importance in the field of basic research include the use of radioactive tracers for marking insects in studies of their ecology and dispersion, and also for recognising predators or determining the feeding habits of possible parasites from the radioactivity they acquire from their marked hosts, and the possibility of controlling certain insects by sterilising irradiation from radio-isotopes or with X-rays. Reference in the last connection is also made to the probability that large amounts of highly radioactive reactor wastes will become available in the future, and the possibility that they could be put to use for the control of eggs and larvae of mosquitos and other insects where these breed in numbers in uninhabited places.

The possibility of using radio-isotopes in studying transmission of disease by arthropods is a very promising but almost unexplored field, though it has been found possible to impart radioactivity to certain nematodes, protozoa, bacteria and viruses that are not, or not normally, insect-borne, and also to adults of *Onchocerca volvulus* and parasites of avian malaria in their vertebrate hosts. In experiments on the radioactive marking of *Plasmodium gallinaceum*, however, it was observed that ingestion of radioactive phosphorus (P^{32}) by *Aëdes aegypti* (L.) during the period of extrinsic incubation caused the development of the parasite to be arrested in the oöcyst stage. The results are cited of unpublished experiments by the author and his associates in which bacteria labelled with P^{32} were used to study the persistence and multiplication of *Escherichia coli* in flies [*Musca domestica* L.] that ingested it with their food. The difficulty was to ensure that the tracer was chemically bound. Thus in one experiment in which the time

and amount of regurgitation and excretion of the bacteria by the flies was quantitatively checked by plating bacteria and determining radioactivity, correlation between radioactivity and bacterial counts was good during the first few days of the test, but the flies then accumulated P^{32}, indicating that the bacteria were probably not molecularly tagged.

The use of radioactive tracers for insecticides has proved of great value in studies of site of entry or physiological action, and it has also facilitated study of the distribution of an insecticide on a treated surface and has shown promise in assessments of the dissemination of sprays applied from aircraft.

Fuller (H. S.). **Studies of Human Body Lice,** *Pediculus humanus corporis.* **III. Initial Dosage and ambient Temperature as Factors influencing the Course of Infection with** *Rickettsia prowazeki.*—*Amer. J. Hyg.* **59** no. 2 pp. 140–149, 14 refs. Baltimore, Md., 1954.

Groups of standard females [*R.A.E.*, B **43** 52] of *Pediculus humanus humanus* L. (*P. h. corporis* Deg.) were given meals containing measured doses of viable rickettsiae (*Rickettsia prowazekii*) by a membrane technique [**40** 16] and were then kept under controlled conditions of temperature and humidity and fed once daily on a normal rabbit. Each group was examined periodically for dead or moribund lice, and these were studied individually for the presence of rickettsiae in smears of intestinal tissue and contents. It was found that the initial dose of rickettsiae and the temperature of incubation influenced the course of infection in the lice, and that the effects were quantitatively reproducible. The rickettsiae multiplied at temperatures throughout the range studied (22 to 38°C. [71·6 to 100·4°F.]). In the range 25·6–34·5°C. [78·08–94·1°F.], the life of the lice was significantly shortened by infections that followed the ingestion of 1,300 ID50 [median infective doses]. Infected and uninfected lice lived the same length of time at 35·8°C. [96·44°F.].

When lice were given different doses of rickettsiae and incubated at 34·5°C., a 100-fold difference in initial dosage was needed to produce a significant difference between mean lengths of life of groups of lice. Initially minimal numbers of rickettsiae multiplied to fatal levels in seven days. The length of life of lice that ingested 1,300 ID50 showed an inverse relation with ambient temperature throughout the range 25·6 to 35·8°C. The louse that lived longest, 26·2 days, was incubated at 25·6°C. The lengths of life of lice maintained alternately for six hours at 31·9°C. [89·42°F.] and for 18 hours at 25·6°C. and of lice maintained for 7 hours after ingestion of rickettsiae at 31·9°C. and thereafter at 25·6°C. did not differ significantly from the length of life of lice kept constantly at 25·6°C.

The observations are discussed in relation to the influence of temperature on biological relationships between lice and *R. prowazekii*.

Melnick (J. L.), Emmons (J.), Coffey (J. H.) & Schoof (H.). **Seasonal Distribution of Coxsackie Viruses in urban Sewage and Flies.**—*Amer. J. Hyg.* **59** no. 2 pp. 164–184, 2 figs., 14 refs. Baltimore, Md., 1954.

Samples of sewage and flies (blowflies and *Musca domestica* L.) were tested for Coxsackie viruses for consecutive periods of 1½–3½ years in 1948–51 in urban areas of Arizona, Connecticut, Kansas, Michigan, New York and West Virginia. The areas are described. *M. domestica* was the predominant fly in Arizona, but was very greatly outnumbered by blowflies in the eastern States. The flies were taken in bait traps or cone nets [*R.A.E.*, B **39** 133]. Of 1,929 tests made, 269 were positive, 29 of them with flies.

In most of the areas studied, virus appeared in some of the specimens collected in the summer and autumn but not in winter or spring, though occasional winter specimens were positive. The frequency with which virus was recovered during the months of peak occurrence varied in the same community from year to year, ranging from 10 per cent. to 50 per cent. or more. Virus was recovered from flies in all the States except New York, and in the months June–October, but recovery was less regular from flies than from sewage. In West Virginia in June–September 1952, 12 of 73 samples of flies were positive, including three of 18 in June before virus appeared in sewage. Only in Charleston, West Virginia, between June and August 1952, were sufficient data available for the recovery of virus from flies taken in bait traps and in cone nets to be compared. No significant difference between the methods was revealed.

In general, the strains isolated caused only myositis in infant mice, but some were neurotropic as well as myotropic, and others caused lesions in the skeletal muscles only or in the brains only. The 80 isolates studied belonged to various antigenic types, and two types occurred together in eight isolates. In one town, one type was present in the summer and was replaced by a second in the autumn. Virus was found in the influent and effluent flow at sewage plants, but it was sometimes recovered from residential areas while the sewage at the disposal plant was negative.

Fuller (H. S.). **Studies of Rickettsialpox. III. Life Cycle of the Mite Vector,** *Allodermanyssus sanguineus*.—*Amer. J. Hyg.* **59** no. 2 pp. 236–239, 12 refs. Baltimore, Md., 1954.

Observations on the life-cycle of *Allodermanyssus sanguineus* (Hirst), the vector of rickettsialpox [*R.A.E.*, B **37** 165], were made on mites collected from house mice from two towns in Massachusetts and on their progeny. The mites were maintained in individual containers at 23–24°C. [73·4–75·2°F.] and a relative humidity of about 80 per cent. and were fed on suckling white mice. The stages of the life-cycle were observed to be egg, larva, protonymph, deutonymph and adult. Larvae did not feed, but nymphs of both stages were active and fed once, and the adults of both sexes fed several times. Protonymphs engorged in less than one hour. Females laid viable eggs after each feed and often began to oviposit within 2–5 days of feeding. The egg, larval, and two nymphal stages lasted 4–5, 3, 4–5 and 6–10 days, respectively, when the nymphs could feed as soon as they were ready to. The nymphs were quiescent in the last two days of each stage. Protonymphs sometimes lived as long as ten days without feeding, but mortality was considerable by the seventh day. Unfed and fed adults survived maximum observation periods of 51 and 63 days, respectively. An attempt to start a laboratory colony with ten nymphs and adults failed, probably because the number of mites (the greatest available) was too small.

Heisch (R. B.). **Studies in Leishmaniasis in East Africa. I. The Epidemiology of an Outbreak of Kala-azar in Kenya.**—*Trans. R. Soc. trop. Med. Hyg.* **48** no. 6 pp. 449–464, 4 figs., 12 refs. London, 1954.

Visceral leishmaniasis (kala-azar) was almost unknown in Kenya until 1941 [*R.A.E.*, B **32** 87], but has since been reported from Saricho and Ngomeni [**42** 166] and the Machakos District and is probably more widely distributed than this. It is usually of sporadic occurrence, but sharp outbreaks have been known. The epidemiology suggests an animal reservoir. An account is given of a study of the epidemiology of an outbreak in the Kitui District that began in 1952, reached a peak in June 1953 and was still

continuing, though apparently on the decline, in May 1954. Nearly 3,000 people were infected, of whom 70 per cent. were males and 5·4, 29·5 and 28 per cent. were 0–3, 4–9 and 9–18 years old. Most of the infections appear to have been contracted at about 2,000 ft. above sea level. Investigations were begun early in 1953 to discover the vector and to determine whether there is a reservoir host.

Over 5,000 sandflies (*Phlebotomus*) were examined and many hundreds dissected. The species found comprised *P. affinis* Thdr., *P. clydei* Sinton, *P. antennatus* Newst., *P. bedfordi* Newst., *P. schwetzi* Adl., Thdr. & Parr., *P. kirki* Parr. and *P. squamipleuris* Newst., and eight that were undescribed. Two of the undescribed species, which belonged to the subgenus *Sergentomyia*, are referred to below as S 1 and S 2; a third, which was related to the group of *P. major* Annan., was the only member of the subgenus *Phlebotomus* taken during the investigation. The habitats in which the sandflies were found included gerbil burrows, termite hills, tree-holes, clefts in rocks, holes in earthy banks and wells. Only a few were in huts or other buildings. Precipitin tests showed that 104 blood smears from *P. clydei*, 41 from *P. antennatus*, 44 from *P. bedfordi*, 14 from *P. schwetzi*, 12 from *P. squamipleuris* and the only one obtained from the species of the subgenus *Phlebotomus* were all negative for human blood, and that 43 of the smears from *P. clydei* were positive for gerbil blood. One specimen out of 18 from *P. kirki*, two out of 16 from S 1 and eight out of 37 from S 2 were positive for human blood [*cf.* **36** 133]. These are the only species proved to bite man in the district.

S 1 and S 2 appeared in large numbers in the ventilation shafts of termite hills after the rains and bit man near the hills in the evenings, though it is probable that both usually feed on lizards. Africans often rest near the termite hills in the evenings, and this may be where infections are contracted. S 2 was the only one of the three man-biting species in which flagellates were found; of 200 examples dissected, 16 contained crithidia (probably derived from lizards) and two contained leptomonads, and all these infections were in the anterior part of the mid-gut. This sandfly is widely distributed through the affected area, persists for several months after each rainy period and predominates in human-baited trap-nets. It is regarded as the most likely vector in the epidemic, though attempts to infect it in the laboratory failed and the leptomonads found in it in nature have not been identified. On one occasion, an individual of this species was caught trying to bite an African. It inserted its proboscis several times but failed to draw blood. Dissection revealed a heavy "anterior" infection of leptomonads, which were inoculated into a hamster. Neither the African nor the hamster had developed leishmaniasis six months later. A few individuals that fed on a patient in an advanced stage of the disease and 30 that fed on an infected hamster after the skin had been infiltrated with a heavy culture of *Leishmania donovani* were all negative for flagellates when dissected five days later.

P. kirki and S 1 are unlikely to be of importance, as they persist for only a short time after the rains, occur in large numbers in only one area and have not been found naturally infected with leptomonads. *P. clydei*, which infests gerbil burrows, was found infected with leptomonads in the anterior part of the mid-gut, but they were almost certainly derived from a lizard that inhabits empty burrows. *P. clydei* is not known to bite man in Kenya. It sometimes entered huts but rarely rested on walls. Two out of four individuals fed on an infected hamster developed "anterior" infections [*cf.* **43** 71]. The species of the subgenus *Phlebotomus* was found in small numbers in huts, latrines and termitaries. Its habits resemble those of *P. orientalis* Parr. [*cf.* **43** 70, etc.], which seems absent from the Kitui

District. Sandflies were not caught biting in houses or other buildings. The species predominating in native huts were *P. bedfordi*, *P. antennatus* and *P. schwetzi*, which feed on geckoes [*cf.* **42** 166]. Only a few people were infected in each village. It is therefore thought unlikely that transmission takes place in huts.

Gland smears from over 100 dogs were negative for *Leishmania*, as were spleen smears from a variety of other animals examined, including 30 jackals, 30 mongooses (*Helogale*) and over 330 gerbils (*Dipodillus* and *Taterillus*), but two hamsters, one inoculated with the pooled organs of several gerbils and the other with emulsified spleen of three mongooses, became infected. However, cross infection may have occurred in the laboratory.

Giglioli (G.). **Residual Effect of DDT in a controlled Area of British Guiana tested by the continued Release of *Anopheles darlingi* and *Aedes aegypti*: a practical Technique for the Standardized Evaluation of over-all residual Efficiency under Field Conditions.**—*Trans. R. Soc. trop. Med. Hyg.* **48** no. 6 pp. 506–521, 3 figs., 8 refs. London, 1954.

Technical difficulties in ascertaining the duration of effectiveness of insecticide deposits in the field by either chemical or biological tests are pointed out, and an account is given of trials of a new technique for assessing the duration of effectiveness of DDT deposits in preventing re-establishment of *Anopheles darlingi* Root and *Aëdes aegypti* (L.) in the inhabited coastlands of British Guiana, from which these mosquitos were eradicated in 1947 [*R.A.E.*, B **37** 40]. Large numbers of the two species were released continuously from an open-air laboratory between August 1949 and July 1952 in Mon Repos, a small, isolated village, formerly a favourite haunt of *Anopheles darlingi* and subject to hyperendemic malaria. All the houses in this village had been sprayed six times between February 1945 and February 1949 with DDT, at 100 mg. per sq. ft. for the first treatment and 150 mg. for the others, and were subsequently left untreated. Over 95,000 larvae and pupae of *A. darlingi* and over 149,000 of *Aëdes aegypti* were used for the introductions and a large proportion of them developed to the adult stage and escaped, but no adults could be found in houses or larvae in the highly suitable ground waters and rain-water collections of the area during careful observations made over 42 months from the last application of DDT. In concurrent experiments with larvae exposed in open bowls in houses to test for the presence of air-borne DDT dust, only one larva out of 434 of *Aëdes aegypti* exposed and none of 324 of *Anopheles darlingi* reached the adult stage, whereas 72 and 51 per cent. of larvae, respectively, developed normally in covered bowls. Further experiments with a simplified technique yielded similar results. Houses at Mon Repos were primitive, with rough walls that favoured retention of DDT, and little cleaning was done by the inhabitants. DDT air-borne dust was effective after three months but not after six in communities with better constructed and cared-for houses.

The experiment at Mon Repos suggests that accurate knowledge of the duration of adequate over-all effect of insecticide deposits under local physical and social conditions can be obtained by releasing *Aëdes aegypti*, a species easy to colonise and one known to be able to re-establish itself readily in cleared territory. If it is not present in the locality, the suitability of the environment should be tested by releases before any spraying is carried out, and breeding places should be provided if they are lacking. The American strain of *A. aegypti* should be used, as it is more anthropophilous and endophilous than the African one and therefore can be more easily eradicated at the conclusion of the experiment. The susceptibility to the insecticide of

the species of *Anopheles* to be controlled can be compared with that of *Aëdes aegypti* by tests in the laboratory.

JORDAN (P.). **Microfilariae in Dejecta of Mosquitoes.**—*Trans. R. Soc. trop. Med. Hyg.* **48** no. 6 p. 537, 3 refs. London, 1954.

Reid found microfilariae in blood-tinted dejecta passed by females of *Anopheles barbirostris* Wulp while they were feeding on a patient whose blood contained microfilariae of *Wuchereria malayi* [*R.A.E.*, B **42** 165], and L. Kartman has reported a similar finding when *A. quadrimaculatus* Say fed on a dog harbouring *Dirofilaria immitis*. The author fed females of *Aëdes aegypti* (L.) on monkeys infected with *D. aethiops* and females of *Culex pipiens fatigans* Wied. on patients harbouring *W. bancrofti* and observed that both species pass clear fluid at the time of feeding. After 2–3 days, however, they passed dejecta containing the remains of the blood-meal for 24–48 hours, and microfilariae of the two infections were often found in the latter, their number varying greatly with individual mosquitos. These findings help to explain the gradual reduction in the number of microfilariae found in mosquitos dissected on consecutive days following an infected blood-meal and possibly also the lack of relationship between the number of microfilariae in blood of the donor and the number of developmental forms found later in the mosquitos.

JACKSON (N.). **Observations on the Feeding Habits of a predaceous Mosquito Larva, *Culex* (*Lutzia*) *tigripes* Grandpré and Charmoy (Diptera).**—*Proc. R. ent. Soc. Lond.* (A) **28** pt. 10–12 pp. 153–159, 6 refs. London, 1953.

As the larvae of *Culex tigripes* Grp. appear to feed almost exclusively on larvae of other mosquitos, their feeding habits were studied in the laboratory at Ibadan, Nigeria, with a view to estimating the part they play in mosquito control in nature. The numbers of mosquito larvae eaten were large and varied with the size of the prey. One individual ate 88 larvae of *Aëdes aegypti* (L.). To determine the ability of *C. tigripes* to develop on food other than mosquito larvae, three second-instar larvae were left unfed, three were fed on dog-biscuit crumbs and three on dried yeast. One of those reared on yeast reached the adult stage, one died in the pupal stage and one died as a larva after ten days. The unfed larvae and those fed on dog-biscuit survived for only 3 and 4–5 days. As it has not yet been found possible to rear *C. tigripes* through a complete life-cycle in the laboratory, it is not known whether the cycle can be completed on yeast. When *C. tigripes* was given a choice of larvae of three species, it took *A. aegypti* first on 61 occasions, *Culex* sp. on four and *Anopheles gambiae* Giles on five. The apparent preference for *Aëdes aegypti* was shown to be due to its greater mobility. *C. tigripes* made little attempt to find prey if there was none near it, and ate much less in a large container than in a small one. It showed little spontaneous movement but more induced movement than *Anopheles gambiae* or the other species of *Culex*. It was more sensitive to a general vibration caused by tapping the container than to a direct stimulation caused by touching the larva itself. If *C. tigripes* does not hunt for its prey, it would probably never eliminate other larvae from a habitat. However, it is not uncommon to find it in a natural habitat with no other larvae present, and in such cases it may have eliminated other species.

Jackson (C. H. N.). **The Hunger-cycles of *Glossina morsitans* Westwood and *G. swynnertoni* Austen.**—*J. Anim. Ecol.* **23** no. 2 pp. 368–372, 1 graph, 3 refs. London, 1954.

Earlier experiments had shown that although *Glossina morsitans* Westw. occupies a shady habitat and *G. swynnertoni* Aust. a less shaded and more arid one, unfed males of *G. morsitans* were more resistant to desiccation than were those of *G. swynnertoni*, losing a significantly lower proportion of their initial weight when exposed to identical conditions of temperature and humidity [*R.A.E.*, B **34** 197–198]. It was therefore thought that *G. swynnertoni*, which contains proportionately less fat and more non-fatty solids than *G. morsitans* and lives in a habitat much better stocked with large game animals, might synthesise less food reserves from the blood-meal but feed more frequently. The hunger-cycles of the two species were accordingly examined by catching, weighing, differentially marking, releasing, recapturing and reweighing males of *G. swynnertoni* at Shinyanga and of *G. morsitans* at Kakoma in the middle of the dry season (September) in 1948 and 1951. The two places have very similar climates at this time, but Shinyanga was somewhat drier. The mean initial weights of non-teneral males of *G. morsitans* destined to be recaptured were 30 mg. in 1948 and 29·8 mg. in 1951 and those of males of *G. swynnertoni* were 25·4 mg. in both years. The length of the hunger-cycle was estimated from the variance in weight difference classified by length of interval between release and recapture, maximum variance indicating the half cycle and minimum variance the whole cycle. The results and the significant differences are given in tables and a graph; they showed that the cycle was 3–4 days for *G. morsitans* and 2·5–3 for *G. swynnertoni*. The cycles would probably be twice as long at the end of the rains.

Ferguson (F. F.). **Biological Factors in the Transmission of American Arthropod-borne Virus Encephalitides. A Summary.**—*Publ. Hlth Monogr.* no. 23, [4+] 37 pp., 14 pp. refs. Washington, D. C., 1954.

The course of investigations on the transmission and reservoirs of St. Louis encephalitis and western and eastern equine encephalomyelitis and their distribution is reviewed from selected literature published up to the end of April 1952. Special attention is given to the entomological aspects of the subject. Many of the results are summarised in tables. These show the results of attempted isolations of virus from arthropods taken in nature and of attempted direct virus transmission by bite and indirect transmission by laboratory methods, arranged under the names of the arthropods, the results of tests of naturally infected warm-blooded hosts for neutralising antibodies and of tests to find encephalitis virus in warm-blooded animals in nature, a reference index of various hosts used in laboratory studies and a chronological table of the main events and discoveries on encephalitis diseases from 1947 to 1951.

The limited published data on other arthropod-borne viruses found in America and able to cause encephalitis is very briefly reviewed. They include the Hammon-Reeves or California virus isolated from *Aëdes dorsalis* (Mg.) [and *Culex tarsalis* Coq.] in Kern County [*R.A.E.*, B **36** 192; **38** 193], several isolated from various mosquitos in Colombia and one in Brazil [**32** 184; **38** 107], and the virus of Venezuelan equine encephalomyelitis, a disease of man and equines now established in Venezuela, Trinidad, Colombia and Ecuador [*cf.* **33** 69, etc.].

Browning (T. O.). **Water Balance in the Tick** *Ornithodoros moubata* **Murray, with particular Reference to the Influence of Carbon Dioxide on the Uptake and Loss of Water.**—*J. exp. Biol.* **31** no. 3 pp. 331–340, 6 graphs, 7 refs. London, 1954.

The following is virtually the author's summary. A study has been made of the exchanges of water between the atmosphere and the tick, *Ornithodoros moubata* (Murr.). Unfed nymphs are able to abstract water from moist air (95 per cent. relative humidity) and to restrict their rate of water loss in dry air. This ability is lost (*a*) in atmospheres containing 30–45 per cent. carbon dioxide; (*b*) in atmospheres containing more than 90 per cent. nitrogen; (*c*) immediately after the tick is fed; (*d*) gradually after the tick has been starved for some five months. It has been shown that the effect of high (30–45 per cent.) concentrations of carbon dioxide is mainly upon the activity of the epidermal cells, possibly mediated through the central nervous system. The concentration required to cause opening of the spiracles is only about 5 per cent.

Pritulin (P. I.). **On the Transmission of Brucellosis by the Pasture Ticks** *Dermacentor nuttallia* **and** *Hyalomma marginatum*. [*In Russian.*]—*Veterinariya* **31** no. 7 pp. 31–33. Moscow, 1954.

The abundance of *Dermacentor nuttalli* Olen. and, to a less extent, *Hyalomma marginatum* Koch, on farms in districts in the Soviet Union in which outbreaks of brucellosis of cattle had occurred led to the assumption that these ticks were responsible for the transmission and spread of the disease since all other sources of infection were absent [*cf. R.A.E.*, B **35** 112, 159]. In tests in 1950, 120 examples of *D. nuttalli* and 30 of *H. marginatum* were taken from infected cows in May. Some of the ticks were fully engorged, but most had apparently not completed feeding. They were kept in test-tubes for eight days, during which period the females laid large numbers of eggs, and were caged on 1st June with two healthy guinea-pigs, to which the examples of *D. nuttalli* attached themselves within two days. Both animals gave positive serological reactions 30 days later. One of them died on 15th July, and bacteriological examination of the carcass also indicated infection with brucellosis. The second ceased to give positive reactions in September and was killed by bleeding in November. Dissection showed pathological changes, which are described, and an emulsion of the internal organs injected subcutaneously into two healthy guineapigs resulted in positive serological reactions from one of them two weeks later and doubtful reactions from the other.

On 15th September, over 25 young examples of *D. nuttalli* of a second generation were found in the cage containing the original two guineapigs. They were inactive, probably owing to the onset of cold weather, and only four attached themselves to the two healthy guineapigs with which they were caged. No infection was produced during the subsequent three months.

A suspension prepared from the eggs of both species laid in the test-tubes was found to contain short ovoid rods. It was injected subcutaneously into a healthy guineapig on 5th June, and serological reactions were obtained from the latter until 21st September. The guineapig was killed in mid-November, and subcutaneous injection of its organs into two healthy guineapigs produced no infection, negative results being given in serological tests over the subsequent two months.

It is concluded from these investigations that pasture ticks probably transmit and preserve the causal agent of brucellosis under natural conditions.

(1931) Wt. P8522/3895 10/55 E.P. Ltd. Gp. 566 [B] A

Breev (K. A.) & Savel'ev (D. V.). **The Control of the Reindeer Warble-fly.** [*In Russian.*]—*Veterinariya* **31** no. 7 pp. 35–37, 3 figs. Moscow, 1954.

Experiments to find ways of protecting reindeer from attacks by *Hypoderma tarandi* (L.) by destroying the females during their oviposition period were begun in the Province of Murmansk in 1950. Driving the animals through a cloud of finely dispersed oil solution of DDT and BHC, or treating them in special chambers within a pen resulted in a sharp decrease in the adults of *H. tarandi* and of other harmful Diptera in places occupied by the herd and greatly reduced subsequent infestation by the warble-fly larvae, but these methods proved unsuitable for practice. A method of treating a whole herd in the open was evolved in 1951. The animals were allowed to congregate in the manner naturally adopted by them as a protection against attack by the warble-flies, which avoided unnecessary disturbance, and were then sprayed with an emulsified solution of DDT and BHC. Emulsion concentrates containing 20 per cent. BHC and 20 per cent. DDT were mixed together and the mixture was diluted 1 : 3 with water from neighbouring lakes or pools; 33 lb. of each concentrate was required to treat a thousand reindeer, and 7–8 treatments were necessary during the summer. The spray was applied from a hand-operated spray pump through two hoses leading to nozzles each attached to the top of a long pole held by a man. The two poles were used simultaneously and the men moved them about so as to ensure even treatment of all the animals. In this way, a herd of some 2,000–3,000 reindeer could be treated in under two hours, the spray, which consisted of fine droplets, being carried by the wind and settling on the animals and the surrounding vegetation. The results obtained when one herd of 3,200 reindeer was treated six times between 20th July and 1st September 1953 are given in a table showing the numbers of *H. tarandi*, *Cephenemyia trompe* (Modeer) and Tabanids that approached a single animal during the 30 minutes before and the 30 minutes after spraying. BHC was omitted from the spray on the first two dates, and the total numbers of these insects dropped from 20, 3 and 4 to 4, 1 and 0 after the first application and from 18, 3 and 5 to 3, 0 and 0 after the second. When both insecticides were used in the spray, it provided complete protection for the 30-minute period and the beneficial effect lasted until the evening. Numerous adults of *H. tarandi* and other Diptera were killed by the spray while it was being applied. To obtain the best results, treatment should be carried out between 11 a.m. and 3 p.m. on fine days, when the insects are most active, and it should be repeated as soon as *H. tarandi* again becomes numerous.

Balashov (Yu. S.). **Peculiarities of the Day-and-Night Rhythm of the Dropping of engorged Females of *Ixodes persulcatus* from Cows.** [*In Russian.*]—*Dokl. Akad. Nauk SSSR* (N.S.) **98** no. 2 pp. 317–319. Moscow, 1954.

The observations described were carried out in the Province of Leningrad in 1953 on cows that were on pasture by day and in sheds by night except during the last third of June, when they were pastured during the night and kept in sheds by day to protect them from blood-sucking flies. The position of attachment and condition of females of *Ixodes persulcatus* Schulze on 25 animals were recorded when they entered and left the shed, so as to ascertain when the ticks became fully engorged and when they dropped from their hosts. It was found that they remained attached for 6–7 days but ingested most blood during the last 10–12 hours of engorgement, when their weight increased 2–3 times, and completed engorgement only when the cows

were in the shed, whether this was by night or by day. Of the 172 ticks that dropped from the cows during six days of observations from 25th to 30th May, when the animals were pastured by day, and of the 78 that did so during six days from 21st to 26th June when the animals were pastured by night, 171 and 77, respectively, dropped in the pasture.

It is concluded that the times of full engorgement and dropping depend on the physiological functions of the host; the ticks do not complete engorgement unless the cows are at rest and do not drop unless they are active, as they are on the pastures. Support for this conclusion was obtained during the periods of change to and from pasturing by night. On 19th June, the cows were driven to pasture at 7 a.m. but were brought back to the shed two hours later and kept there till evening. Of the ticks that had completed engorgement during the preceding night, some dropped during the two morning hours on the pasture, but all the others remained on the cows throughout the day, though they did not apparently ingest any more blood, and these, together with additional ticks that completed engorgement during the day, all dropped on the pasture during the following night. No tick dropped in the shed on 19th June. The change back to day pasturing was made by keeping the cows in the shed for 24 hours from the morning of 27th June. Of 19 ticks that completed engorgement during the first 12 hours, two dropped in the shed during the night and all the others dropped in the pasture next day. After this, when the cows were in the shed only at night, all ticks dropped in the pasture.

Chumakov (M. P.). **Queensland Fever—a zoonotic Rickettsiosis of Man and Animals.** [*In Russian.*]—*Veterinariya* **31** no. 9 pp. 26–32, 3 refs. Moscow, 1954.

The distribution of Q fever, caused by *Coxiella* (*Rickettsia*) *burneti*, its effects in man and domestic animals, and the ways in which it may be transmitted are reviewed from the literature, and records are given of its occurrence in man in the Soviet Union, where it appears to be endemic in various parts of Central Asia. The rickettsiae have also been isolated there from *Hyalomma excavatum* Koch (*anatolicum* Koch), *Argas persicus* (Oken) and mites of the genera *Leeuwenhoekia* and *Dermanyssus*, but it is believed that infection is usually acquired by inhalation of infected dust and not from tick bites, though the dried faeces of the ticks or the dried remains of dead ticks may be an important factor in dust infection. Small temporary outbreaks of the disease have occurred in the European part of the Soviet Union among workers in factories handling cotton brought from the endemic area in Central Asia.

Day (M. F.) & Bennetts (M. J.). **A Review of Problems of Specificity in Arthropod Vectors of Plant and Animal Viruses.**—[3+] 172 pp., 4 figs., 52 pp. refs., multigraph. Canberra, Div. Ent., Commonw. sci. industr. Res. Org. Aust., 1954.

The study of arthropod vectors of virus and rickettsial diseases has provided increasing evidence that any one pathogen can be transmitted by more than one species, and the question arises how many pathogens now thought to be transmitted by a specific vector or restricted group will eventually be shown to be transmitted also by others. A pathogen transmitted by several vectors may be specific to a group similar in crucial aspects of physiology and biochemistry, and can therefore be considered in a study of vector specificity. Investigation of the reasons for the failure to transmit of arthropods thought

likely to be vectors may also yield useful information, even though no solution to many of the problems can be suggested on the basis of available information.

In this review, the problem of the causes of vector specificity is approached from the aspect of insect physiology, both plant and animal viruses are considered, and rickettsiae are also included because they seem in certain respects to form an almost continuous series with the larger animal viruses. The data on which it is based are summarised in an appendix (pp. 23–110) that contains a list of 78 plant viruses, 9 rickettsiae and 28 animal viruses, including representatives of all types of virus–vector relationship. The information for the rickettsiae and animal viruses comprises lists of vector and non-vector species, both in the field and the laboratory, and notes on such points as latent period, the viability of the virus and its multiplication in the vector, and transovarial infection, and the authority is cited in every case, with the appropriate reference to the extensive bibliography (pp. 111–163). There is also an index of the viruses and rickettsiae.

It is clear from the data in the appendix that the concept of specificity is a relative one; examples of the extremes of the range for animal viruses include rabbit myxomatosis, which has no apparent specificity and has been transmitted by all blood-sucking arthropods, and dengue, of which the only definitely proved vectors are three closely related mosquitos of the subgenus *Stegomyia* of *Aëdes*. There are no adequately studied animal viruses that are transmitted by only one species of vector, and the same is true of rickettsiae unless it is considered that trench fever has been adequately studied, but it is not true of plant viruses and at least one of the latter is transmitted only by certain strains of a species [*R.A.E.*, A **20** 717]. Instances in which the same arthropod has been claimed by one author to transmit a virus or rickettsia and by another to be incapable of transmitting, provide further evidence that specificity is not necessarily solely an attribute of a species of arthropod. No information as to the causes of specificity is available in many cases, but sufficient is known in some to indicate where in the transmission cycle a barrier to successful transmission might be expected. The problems of transmission are undoubtedly more complex in viruses that multiply in their arthropod vectors than in those that do not and the causes of specificity are likewise more involved. Among the known causes are feeding behaviour (including preferred tissues and the amount of feeding on the viruliferous or susceptible host), inhibitors in gut or salivary secretions, and occurrence of regurgitation. For viruses with latent periods in their vectors, additional barriers may include mid-gut and salivary-gland permeability and blood inhibitors. In addition, there are the factors of innate and humoral immunity, which have received scant experimental study in insects. Tissue specificity and gut permeability have both been found to be significant contributors to the specificity of insect vectors, but conclusions regarding their relative importance and the place of other barriers may be altered with increasing knowledge.

Sanmartin-Barberi (C.), Groot (H.) & Osorno-Mesa (E.). **Human Epidemic in Colombia caused by the Venezuelan Equine Encephalomyelitis Virus.**—*Amer. J. trop. Med. Hyg.* **3** no. 2 pp. 283–293, 2 graphs, 13 refs. Baltimore, Md., 1954.

An outbreak of a short, mild febrile disease in man occurred in Espinal, Colombia, from March to June 1952. A virus isolated from two patients during the acute phase was identified as a strain of Venezuelan equine encephalomyelitis virus by comparison with a pool of two strains of this virus from Venezuela and Colombia. The epizootic form of the disease is

known to occur in horses in Espinal and other parts of Colombia [*cf. R.A.E.*, B **32** 139]. Very high titres of neutralising antibodies against both the pool and the Espinal strain were demonstrated in ten sera from other persons several weeks after the clinical attack. During the epidemic, *Aëdes aegypti* (L.) was found in 687 of the 2,295 houses in the village and *Culex pipiens fatiyans* Wied. in 214. The end of the outbreak coincided with thorough spraying with DDT. A few females of both mosquitos that were allowed to feed on mice infected with the Espinal strain were shown to contain the virus eight days later by inoculation into fresh mice.

KARTMAN (L.). **Suggestions concerning an Index of experimental Filaria Infection in Mosquitoes.**—*Amer. J. trop. Med. Hyg.* **3** no. 2 pp. 329–337, 1 fig., 10 refs. Baltimore, Md., 1954.

The need for an adequate index of experimental infection in laboratory studies of mosquito hosts of filarial parasites, and concepts of host efficiency are discussed. In recent work on *Dirofilaria immitis*, the author estimated the host efficiency of a group of mosquitos by dissecting some of them early enough to find how many microfilariae they ingested and others daily during the incubation period of the larvae. The ratio of number of developing larvae to number of microfilariae per mosquito was the host efficiency ratio [*R.A.E.*, B **43** 33]. The value of this ratio in comparing host efficiencies of different species of mosquitos is, however, reduced because the percentage of developing larvae that will reach the third (infective) stage may differ with the species, and the author now proposes an efficiency ratio obtained by dividing the number of third-stage larvae per mosquito surviving at the end of the filarial incubation period by the number of microfilariae ingested. The incubation period is arbitrarily selected as one in which infective larvae are known to develop in one or more of the mosquito species.

Two other factors have to be considered. The first is the survival rate of the host, defined as the percentage of engorged female mosquitos surviving the period of extrinsic incubation of the parasite. The second is the infection rate of the host, derived by dividing the number of mosquitos with third-stage larvae at the end of the parasite's incubation period by the number of mosquitos then surviving. It is suggested that the appropriate effects of the three components may be reflected in an index of experimental infection, which is the product of the survival rate, infection rate and efficiency ratio. This index is calculated for various species of mosquitos from data obtained in experiments comparing their susceptibility to *D. immitis*. It is concluded from the results that the index, though subject to certain limitations, is of practical value in that it evaluates simultaneously certain factors that have already been demonstrated to affect the likelihood that a given species of mosquito will be a good host for a filarial parasite.

TRAUB (R.), JOHNSON (P. T.), MIESSE (M. L.) & ELBEL (R. E.). **Isolation of *Rickettsia tsutsugamushi* from Rodents from Thailand.**—*Amer. J. trop. Med. Hyg.* **3** no. 2 pp. 356–359, 9 refs. Baltimore, Md., 1954.

A survey in Siam showed that *Trombicula deliensis* Walch was prevalent in the Nakhon Pathom, Muang Lampaya area, and attempts were therefore made to isolate *Rickettsia orientalis* (*tsutsugamushi*) from livers and spleens of rodents collected there. The 27 rodents tested included 15 bandicoots (*Bandicota* sp.) and eight rats (*Rattus rattus thai*), and the rickettsia was isolated from one pool of three of the bandicoots and one pool of two of the rats. This is the first isolation of *R. orientalis* from rodents in Siam, but

there are records of the occurrence of tsutsugamushi disease in Japanese troops there during the second world war and a serologically confirmed case was reported in 1953.

Calhoun (E. L.). **Natural Occurrence of Tularemia in the Lone Star Tick, *Amblyomma americanum* (Linn.), and in Dogs in Arkansas.**—*Amer. J. trop. Med. Hyg.* **3** no. 2 pp. 360–366, 3 figs., 5 refs. Baltimore, Md., 1954.

Epidemiological investigations by A. M. Washburn & J. H. Tuohy on tularaemia in Arkansas, where 949 human cases were reported in 1946–50, showed that the incidence of the disease was highest in April–September, when ticks are most abundant, and that about 56 per cent. of the cases reported each year had a history of tick bite. Possible tick vectors were therefore investigated in 1951 and 1952. Collections were made in June–August 1951 on various mammals and birds and by dragging. Ticks of five species were taken, but *Amblyomma americanum* (L.) and *Dermacentor variabilis* (Say) comprised 92·8 and 7·1 per cent. of the total, respectively. *A. americanum* was not quite so widely distributed as *D. variabilis*, but occurred over the greater part of the State and predominated in the more mountainous and heavily wooded areas. *Bacterium* (*Pasteurella*) *tularense* was isolated from one batch of *A. americanum* in 1951 and from five out of 242 batches (comprising 12,845 individuals) in 1952. The positive batches were collected from dogs or cows or by dragging. Two of them were composed entirely of adult females. No ticks of other species were positive; those tested included over 2,000 examples of *D. variabilis* and 152 adults of this species that were taken on the same dogs at the same times as infected batches of *A. americanum*.

Tularaemia agglutination tests were made on sera of the seven dogs and three of the cows on which infected ticks had been found in 1952. The results were positive for the sera from six of the dogs in dilutions from 1:40 to 1:640, and for those from the three cows in dilution of 1:80.

Schoof (H. F.) & Siverly (R. E.). **The Occurrence and Movement of *Periplaneta americana* (L.) within an urban Sewerage System.**—*Amer. J. trop. Med. Hyg.* **3** no. 2 pp. 367–371, 1 fig., 8 refs. Baltimore, Md., 1954.

Cockroaches are known to be able to harbour *Salmonella* for several days [*R.A.E.*, B **38** 15; **40** 89; **42** 121], the collection of *Periplaneta americana* (L.) contaminated with three species of *Salmonella* from sewer manholes in Texas was reported by R. S. Bitter & O. B. Williams (1949), and J. T. Syverton & others (1952) recorded the isolation of four strains of poliomyelitis virus from *P. americana*, *Blattella germanica* (L.) and *Supella supellectilium* (Serv.) caught on the premises of patients ill with paralytic poliomyelitis. The movement of *P. americana* in and from city sewerage systems, which might affect its importance as a transmitter of disease, was studied at Phoenix, Arizona, in October 1952. Surveys at 22 manholes for seven weeks had shown a weekly average of 92–143 cockroaches, all of this species, whereas the predominant cockroaches in dwellings were *S. supellectilium* and *B. germanica*.

Some 6,500 individuals of *P. americana* were trapped in sewer manholes, marked with radioactive phosphorus by spraying with a solution containing 5 per cent. casein and 10 microcuries P^{32} per millilitre and released in four manholes. During the next 8½ weeks, traps at three of the release sites

yielded 929 cockroaches, of which 906 were radioactive, 34 traps in other manholes of which most were less than half a mile and the others up to one mile from the release sites yielded 16,021 cockroaches, of which none was radioactive, and ten traps on premises in blocks adjacent to the release sites yielded only one cockroach which was radioactive and was caught 60 ft. from the nearest release site. The lack of evidence of movement was surprising in view of an observed tendency of the species to disperse and the likelihood of induced population pressure at the points at which the cockroaches were released.

MILLER (A.). **Dung Beetles (Coleoptera, Scarabaeidae) and other Insects in Relation to Human Feces in a Hookworm Area of southern Georgia.** —*Amer. J. trop. Med. Hyg.* **3** no. 2 pp. 372–388, 1 pl., 15 refs. Baltimore, Md., 1954.

The dissemination of the hookworms that infest man depends on the contamination of soil with faeces containing eggs or larvae. In south-eastern Georgia, faeces deposited on soil soon disappear in summer. Disturbed soil indicated burial by insects, and dung beetles (Coprids) were found to be responsible. Their activities were therefore investigated near Waycross in July 1951. Human faeces were exposed on the ground or in traps in five localities with sandy soil. The most effective trap was a large (1 U.S. gal.) tin sunk to its rim in the ground, with the faeces supported at ground level on a central pedestal. A one-inch layer of soil in the bottom served as a burrowing and hiding place for the trapped insects. Often 50–100 beetles were caught in 3–15 hours.

Most of the insects taken in association with the faeces were flies and beetles, and tumble-bugs (five species of *Canthon*) and burying beetles (seven species of five other Coprid genera) made up 59 and 28 per cent. of the beetles taken in the traps. The burying beetles bury faeces directly at the site, whereas the tumble-bugs remove them in balls and bury them elsewhere. Both feed on the faeces at least as adults. The tumble-bugs were active mainly by day and buried balls up to 20 ft. from where they found the faeces. Burying beetles were active principally at night. They buried faeces to a depth of 9 inches. It is estimated from average figures, taking into account the differences between the species concerned, that the 361 dung beetles collected in three traps on about 0·2 acre in 24 hours would bury 748 gm. faeces in 24 hours, which could represent the entire daily excrement of a family of 4–6 people.

Of 20 faecal specimens weighing 18–100 gm., five disappeared in 2½ hours and five others completely or almost so in seven hours. Faeces exposed where dung beetles were not abundant or active enough to bury them remained on the ground despite the feeding activities of flies and their larvae and other insects. They persisted longest in dense vegetation.

The amount of faeces that beetles remove from a given site and the rate of removal depend on the numbers attracted, their size (species) and the sequence and rapidity of their arrival. These in turn depend on season, weather, time of day, availability of other food (especially cow dung), type of soil and the character and accessibility of the site. Whether the activities of dung beetles help or hinder the success of parasitic worms depends on a combination of factors that differ according to the biology of the parasites. Burial of faeces need not be detrimental to hookworm, since the larvae can hatch and develop under 36 inches of sandy soil and migrate through it. However, burial and ingestion of faeces by beetles in underground chambers may differ sufficiently from artificial burial to interfere with successful development. Burial of ova, such as those of *Ascaris*, that need to be

ingested by the vertebrate host would make them inaccessible. The larger species of dung beetles excrete large amounts of faeces during feeding and burrowing. This, as well as the transport of mammalian faeces to a distance could be a factor in the dissemination of micro-organisms. The rapid removal of faeces by the beetles may indirectly influence the degree of pollution and worm-infestation of soil by maintaining defecation sites in acceptable condition for repeated use and so increasing the infection potential of particular areas.

Lalonde (D. I. V.) & Brown (A. W. A.). **The Effect of Insecticides on the Action Potentials of Insect Nerve.**—*Canad. J. Zool.* **32** no. 2 pp. 74–81, 3 pls., 9 refs. Ottawa, 1954.

The following is virtually the authors' summary. Solutions of 17 insecticides in maize oil were applied to the leg of *Periplaneta americana* (L.), and their effect on the sensory impulses of the crural nerve was determined by means of a preamplifier and cathode-ray oscillograph. DDT, methoxy-DDT (methoxychlor) and DDD induced well-marked trains of repetitive discharge. Aldrin and dieldrin evoked low-voltage trains of repetitive discharge after a latent period of two to four hours. Technical chlordane, heptachlor, α-chlordane, β-chlordane, and toxaphene all showed considerable latent periods before stimulating the action potentials. Lindane [γ BHC] rapidly induced the appearance of tiny sets of repeat spikes. The pyrethrins increased the frequency of impulses, while DNC and dinex increased both the voltage and the frequency. Schradan showed no effect, TEPP [tetraethyl pyrophosphate] caused a transient stimulation, and parathion induced trains of repetitive discharge after a latent period of three hours.

Hocking (B.) & Pickering (L. R.). **Observations on the Bionomics of some northern Species of Simuliidae (Diptera).**—*Canad. J. Zool.* **32** no. 2 pp. 99–119, 1 fig., 17 refs. Ottawa, 1954.

The following is virtually the authors' abstract. Nine new records of Simuliids bring the total number of species found in northern Manitoba to 21 [*cf. R.A.E.*, B **37** 166]. Observations on the bionomics, especially of *Simulium venustum* Say, are given. The attachment of Simuliid larvae is determined by a mechanical factor, probably the water velocity gradient, perhaps conditioned by visual stimuli. Young larvae were heavily preyed upon by *Hydra* sp. and adults by the white-crowned sparrow, *Zonotrichia leucophrys*. Mermithid worms persisted as parasites in the pupal and adult stages. A method is described by which individuals of several species were reared singly in the field from half-grown larvae to adults, and the exuviae retained. A number of laboratory rearing techniques were tried for *S. venustum* but few larvae moulted from the first to the second instar. Adults did not feed on blood or lay eggs in the laboratory, and there was no evidence of successful mating. The difficulties in laboratory rearing of larvae are thought to be due to a sensitivity to autointoxication. The energy relationships of Simuliids are discussed briefly.

McLintock (J.) & Depner (K. R.). **A Review of the Life-history and Habits of the Horn Fly, *Siphona irritans* (L.) (Diptera: Muscidae).**—*Canad. Ent.* **86** no. 1 pp. 20–33, 48 refs. Ottawa, 1954.

The following is virtually the authors' summary. The available literature on the life-history and habits of *Siphona irritans* (L.) is reviewed and

observations made in the laboratory and in southern Alberta are reported. The adult is an obligate parasite of cattle that remains on its host night and day and leaves it only to deposit its eggs, an operation that requires ten minutes at most. The fly is introduced into new regions only in the company of its host and is generally considered a serious pest, but has not been implicated as a vector of disease. It appears to prefer very high temperatures and humidities, which govern its resting, feeding and egg-laying habits, its length of life, and the number of eggs laid; little is known about these preferences. The adults are stenogamous. The available evidence indicates that mating takes place on the host and within three days after the flies reach it. Mating is not a prerequisite for ovary development and egg-laying.

The eggs require a relative humidity near 100 per cent. and hatch in less than 24 hours between 77 and 94°F. The larvae live only in cattle dung and the nature of the habitat is important in their survival and development, but the physical, chemical and biological conditions of the freshly passed dung have received little attention. The temperature range of development for the larvae is 13–36°C. [55·4–96·8°F.] with the optimum near 32°C. [89·6°F.]. The larvae require a relative humidity of just below 100 per cent. Pupation occurs in the droppings and on the surface of the soil and has been reported as deep as 5 cm. in the soil beneath the droppings. Young pupae appear to require a relative humidity between 94 and 99 per cent. The duration of the pupal stage is reported as 3·8 days at 32·3°C. [90·14°F.] and 14·2 days at 18·2°C. [64·76°F.]. The females begin to emerge first. *S. irritans* undergoes a diapause in the pupal stage in Denmark and southern Alberta, but its nature and the causes of its beginning and end are unknown.

Morrison (P. E.) & Brown (A. W. A.). **The Effects of Insecticides on Cytochrome Oxidase obtained from the American Cockroach.**—*J. econ. Ent.* **47** no. 5 pp. 723–730, 9 graphs, 23 refs. Menasha, Wis., 1954.

The following is based almost entirely on the authors' introduction and summary. Organic insecticides have been shown to have various and characteristic effects on the rate of oxygen consumption of the German cockroach [*Blattella germanica* (L.)] [*R.A.E.*, A **40** 160], DNC has been found to stimulate the respiratory enzyme, cytochrome oxidase, in embryo grasshoppers, and Sacktor showed that DDT and methoxy-DDT (methoxychlor) partly inhibit the cytochrome oxidase of the house-fly [*Musca domestica* L.] and further suggested that resistance to DDT in strains of this fly may be at least partly due to an increased content of the enzyme [B **39** 118; **40** 135].

In the investigations described, the effects of 26 insecticides on the cytochrome c oxidase of coxal muscle tissue from males of *Periplaneta americana* (L.) was ascertained by a manometric method, using phosphate buffer in the enzyme digest. All the insecticides were at molar concentrations of 1×10^{-3} and 1×10^{-5}, except the extracts of ryania and sabadilla, which were at the higher concentration only. All the chlorinated hydrocarbons tested completely inhibited the cytochrome c oxidase at the higher concentration, and caused a slight transient stimulation at the lower one. The inhibition at the higher concentration was rapid in the case of p,p′DDD, p,p′methoxy-DDT, γ BHC and toxaphene, but slower in onset with p,p′DDT, aldrin, dieldrin, heptachlor and the α and β isomers of chlordane. DNC, dinex and dinoseb stimulated the oxidase at the lower concentration, and the last two inhibited it at the higher one. Of the organic phosphates, TEPP [tetraethyl pyrophosphate] was significantly stimulatory at the higher concentration and schradan slightly so, whereas parathion and malathion caused complete inhibition; all four, especially malathion and TEPP, were

stimulatory at the lower concentration. Nicotine stimulated at both concentrations, and rotenone at the lower one, whereas at the higher concentration the pyrethrins and allethrin completely inhibited and rotenone, ryania and sabadilla were weak inhibitors. Phenothiazine and two thiocyanate preparations (Lethane 60 and Lethane 384) markedly inhibited at the higher concentration.

Tsao (Ching-hsi), Hornstein (I.) & Sullivan (W. N.). **The joint Action of chlorinated Terphenyl with Lindane and with Allethrin.**—*J. econ. Ent.* **47** no. 5 pp. 796–798, 4 refs. Menasha, Wis., 1954.

Previous experiments indicated that the duration of toxicity of deposits of γ BHC as lindane is increased by the addition of a mixture of chlorinated terphenyl isomers (Aroclor 5460) [*R.A.E.*, B **41** 143; **42** 74; but *cf.* **43** 135]. The studies described in this paper were carried out to determine whether Aroclor 5460 would increase the toxicity of lindane or allethrin by synergistic action when they were applied topically in acetone solutions to house-flies (*Musca domestica* L.) and also what effect it would have on the toxicity of allethrin deposits. Where applied topically, lindane in a 1:2 mixture with Aroclor was only four-fifths as toxic as it was alone, but allethrin in a 1:1 mixture with Aroclor was 1·3–1·4 times as toxic as allethrin alone. In a comparative test, allethrin in 1:1 mixtures with Aroclor, n-propyl isome and piperonyl butoxide was 1·27, 2·21 and 2·47 times as toxic as it was alone.

The toxicity of the allethrin deposits was estimated by the percentages of flies knocked down in 1 hour and killed in 24 hours by exposure for various periods 1–126 days after the deposits were applied. Deposits of 10 and 25 mg. allethrin per sq. ft., applied alone or in 1:1 or 1:2 mixture with Aroclor, were compared, and the results are given in detail in a table. The Aroclor, particularly in the 1:2 mixture, reduced the initial toxicity of the deposits considerably but prolonged their effectiveness, so that the mixtures became more effective than allethrin alone after 14 days when the allethrin deposits were 10 mg. per sq. ft. and after a longer time when they were 25 mg. With the latter deposit, allethrin alone killed 95 per cent. of the flies exposed for three minutes after 15 days and none of the flies exposed for up to two hours after 126 days, whereas the 1:2 mixture killed 6 per cent. of those exposed for 10 minutes after 15 days and 73 and 95 per cent. of those exposed for one and two hours after 126 days.

Roan (C. C.) & Babers (F. H.). **Factors affecting the Rate of Penetration of DDT.**—*J. econ. Ent.* **47** no. 5 pp. 798–800, 9 refs. Menasha, Wis., 1954.

Experiments indicating that a dosage of DDT greater than the amount that an insect can readily metabolise inhibits its metabolising mechanism [*R.A.E.*, A **38** 331; B **42** 133] suggested the possibility of altering DDT-metabolism by changing the rate of penetration of topically applied doses. Factors that may affect the rate of penetration were therefore investigated. The test insects were males of *Periplaneta americana* (L.), and solutions of DDT in acetone were applied to the ventral cervical membrane with a device that was essentially a micrometer-driven syringe. After the treated cockroaches had been kept in beakers for 24 hours, the external (unabsorbed) DDT was removed from them and the beakers by rinsing with ether, and the amounts of DDT absorbed by them were determined by tests for DDT and DDE [1,1-bis(p-chlorophenyl)-2,2-dichloroethylene] in ether extracts of their bodies. No DDE, however, was detected.

It was soon found that the total amounts of DDT recovered did not account for the theoretically applied doses. This might have been due in part to the presence in the cockroaches of a DDT metabolite other than DDE [*cf.* A **40** 346], but was also at least partly due to failure of the syringe to apply the expected amount. This was ascertained by experiments in which treated filter papers or cockroaches were assayed immediately after treatment and the amounts of DDT recovered were considerably smaller than they should have been. In subsequent experiments, therefore, the theoretical dose was ignored, and the amounts actually applied were considered to be the amounts recoverable from control cockroaches assayed immediately after treatment.

When the higher doses of DDT were applied, some of the cockroaches were dead, or apparently so, at the time of assay. They were not separated from the living ones for analysis, but might have absorbed less DDT if they had died soon after treatment. In a test in which the same amounts of DDT were applied to cockroaches killed by injection of paraoxon two hours before and to cockroaches killed by freezing, the former absorbed nearly four times as much DDT in 24 hours as the latter. Some explanation of the difference may be provided by an observation made in a radiobiological study of organic phosphates [B **39** 1]; treated cockroaches dissected when they were prostrate and apparently dead still had beating hearts. Until a definite test for death has been devised, external appearance must be relied on.

Increases in the amounts of DDT absorbed were obtained by increasing the amount or the DDT concentration of the solution applied, but it is concluded that the possibility of increasing absorption indefinitely is limited by the effects of premature death, the lack of sizeable areas of uniformly constructed exoskeleton to which large volumes of solution can be applied, and the probability that there is an optimum concentration of solution above which increased concentration will not result in correspondingly increased absorption [*cf.* B **41** 122].

PORTMAN (R. F.). **Control of Mosquitoes in California Rice Fields.**—*J. econ. Ent.* **47** no. 5 pp. 818–824, 19 refs. Menasha, Wis., 1954.

The rice acreage in California (412,000 acres in 1953) has approximately doubled in ten years, and a corresponding increase in the mosquito-control problem has resulted [*cf. R.A.E.*, B **41** 43, 204]. *Anopheles freeborni* Aitken, *Culex tarsalis* Coq., *Aëdes dorsalis* (Mg.) and *A. nigromaculis* (Ludl.) are the principal species breeding in the rice-fields. Notes on their bionomics are given. *A. nigromaculis* has gradually been supplanting the fresh-water strain of *A. dorsalis* since 1935. The only practicable method known for controlling larvae of these two species effectively and economically is to mix DDT wettable powder with the damp seed rice applied from aircraft to give a dosage of 0·5 lb. DDT per acre [*cf.* **41** 43], but sprays applied from aircraft and aerosols are effective against the adults.

Anopheles freeborni, the principal local vector of malaria, is the most prevalent species at present, but the breeding intensity of *C. tarsalis*, the main vector of [western equine and St. Louis] encephalitis [**41** 127, etc.], has been increasing since 1952. Both overwinter as adults, which oviposit in early spring in borrowpits, ditches and puddles. The adults overwintering in buildings or other shelters can be controlled by aerosols applied from thermal generators, or preferably by DDT deposits, and larvicides applied in spring delay and reduce the initial infestation of the rice-fields. Complete control of the breeding occurring in the rice-fields during summer is not attempted. Adults invading urban and suburban areas are controlled

by aerosols. A formulation that has been successfully used for five years consists of 10 per cent. DDT and 2 per cent. Lethane 384 [50 per cent. n-butyl carbitol thiocyanate] in diesel oil with the addition of a less volatile petroleum by-product that serves as an auxiliary solvent for the DDT and makes the aerosol heavier and more dense. Aerosols must be considered as only a supplementary means of control because optimum conditions for their use are of sporadic occurrence.

Adults of all four species can be controlled in rural areas by sprays applied from aircraft. A spray formulation consisting of 2 per cent. Lethane 384 and 0·024 lb. dieldrin in emulsified solution per U.S. gal. applied at 4 U.S. gals. per acre gave almost 100 per cent. control of adults and also of *Aëdes* larvae, but was not effective against larvae and pupae of *C. tarsalis*. Another formulation was applied from aircraft in 1950–54 for treating rice-fields ten days or less before draining. It consisted of 0·8 lb. DDT per U.S. gal. with 2 per cent. by volume Lethane 384, 0·5 per cent. Triton B-1956 as spreading agent, 71·5 per cent. diesel oil and 20 per cent. of the petroleum by-product, which improved the film on water. In 1950, the formulation was applied as a thermal (exhaust) aerosol at 0·19 U.S. gal. per acre and gave high mortality of adult mosquitos and 94–98 per cent. control of *Anopheles* larvae. During the next four years, 155,000 acres of rice-fields were treated with it, but it was applied from a spray boom at about 0·27 U.S. gals. per acre. It again caused high mortality of mosquitos and of *Anopheles* larvae, but did not control larvae of *C. tarsalis* in spite of a progressive increase in the concentration of Lethane 384. Small numbers of surviving mosquitos and those produced by recurring infestations of the rice-fields and adjacent breeding sites after treatment did not constitute a pest problem during the last three years of the operations. The increasing prevalence of *C. tarsalis* and its increasing resistance to insecticides presents a serious problem with regard to encephalitis.

Schoof (H. F.) & Siverly (R. E.). **Multiple Release Studies on the Dispersion of *Musca domestica* at Phoenix, Arizona.**—*J. econ. Ent.* **47** no. 5 pp. 830–838, 3 figs., 8 refs. Menasha, Wis., 1954.

The relative importance of five major sources of house-flies (*Musca domestica* L.) near Phoenix, Arizona, on the control programme in operation in the town was studied in 1952. Flies marked with radioactive phosphorus (P^{32}) and a dye characteristic of the site [*R.A.E.*, B **41** 172] were released simultaneously from the five sites, and catching stations were operated at the release sites themselves, 0·5 and 1 mile from each site in all directions and 2, 3 and 4 miles from each site in the direction of the centre of the town. The recaptures are discussed in some detail. The following is based on the authors' summary of the findings. Flies from three sites, two on the periphery of the town and one 0·5 mile away, readily infiltrated into the town itself, but comparatively few flies from sites 1·8 and 2 miles away did so. From 59 to 81 per cent. of the marked flies recovered were taken within 1 mile of the release points and from 86 to 94 per cent. within 2·3 miles. Maximum recovery of marked flies occurred at release sites on the first day after release and at other sites on the fourth day. Available evidence indicates that although house-flies can travel 5–20 miles, the dispersion capacity of the mass population is expended within 0·5–2 miles because of the randomised, reciprocal type of meandering that characterises house-fly movement [*cf.* **41** 43]. One mile is the distance to which it is recommended that fly control operations should be extended outside most communities.

Gersdorff (W. A.), Mitlin (N.) & Beroza (M.). **Comparative Effects of Sesamolin, Sesamin, and Sesamol in Pyrethrum and Allethrin Mixtures as House Fly Sprays.**—*J. econ. Ent.* **47** no. 5 pp. 839–842, 5 refs. Menasha, Wis., 1954.

Four crystalline constituents separated from sesame oil were tested as synergists for pyrethrins or allethrin in kerosene sprays applied against *Musca domestica* L. by the turntable method [*R.A.E.*, B **26** 246]. The four constituents were sesamin, sesamol (3,4-methylenedioxyphenol), sesamolin, which is believed to be structurally identical with sesamin except that one of the two methylenedioxyphenyl groups is attached as an ether to the central nucleus, and a sterol of unknown structure that does not contain a methylenedioxyphenyl group. Sesamol and the sterol had no synergistic effect with pyrethrins, but pyrethrins in 1 : 1 and 5 : 1 mixtures with sesamolin and 1 : 1 mixture with sesamin were, respectively, about 31, ten and eight times as toxic as they were alone. Allethrin in the three corresponding mixtures was only about 1·4, 1·3 and 1·5 times as toxic as it was alone. All the sprays containing pyrethrins or allethrin caused complete, or nearly complete, knockdown of flies, whereas sprays containing sesamin or sesamolin alone caused no knockdown.

Gersdorff (W. A.) & Mitlin (N.). **The relative Toxicity of some Aryl Analogs of Allethrin to House Flies.**—*J. econ. Ent.* **47** no. 5 pp. 888–890, 3 refs. Menasha, Wis., 1954.

Allethrin and five analogues in which aryl groups were substituted for the allyl group were tested in kerosene sprays against *Musca domestica* L. by the turntable method [*R.A.E.*, B **26** 246]. The phenyl, benzyl, o-methoxybenzyl, p-methoxybenzyl and 3,4-methylenedioxybenzyl analogues were, respectively, 34, 18, 7, 2 and 6 per cent. as toxic as allethrin. All the analogues possessed considerable knockdown value.

Mitlin (N.), Konecky (M. S.) & Piquett (P. G.). **The Effect of a Folic Acid Antagonist on the House Fly.**—*J. econ. Ent.* **47** no. 5 pp. 932–933, 5 refs. Menasha, Wis., 1954.

The following is virtually the authors' summary. The sodium salt of aminopterin, a structural analogue of folic (pteroylglutamic) acid, when added to standard rearing medium [*R.A.E.*, B **37** 89] at concentrations of 0·1, 0·05, 0·025 and 0·0125 per cent., prolonged the larval stage of *Musca domestica* L. The first two concentrations prevented adult emergence altogether, and the third reduced emergence considerably.

Folic acid in concentrations of 0·0025, 0·025 and 0·1 per cent. reversed the action of the aminopterin salt when added to cultures containing 0·025 per cent. of it. Added by itself at concentrations up to 0·1 per cent., folic acid appeared to cause no change in development of the fly.

Harrison (F. P.), Ditman (L. P.) & Bickley (W. E.). **Habits of *Drosophila* with Reference to Animal Excrement.**—*J. econ. Ent.* **47** no. 5 p. 935, 3 refs. Menasha, Wis., 1954.

As it has been suggested that some species of *Drosophila*, including *D. repleta* Woll., are attracted to human excrement and so might spread disease [*R.A.E.*, B **8** 1; *cf.* also **42** 122], tests were made of the attractiveness of excrement to species common in tomato fields [*cf.* A **43** 325].

Traps baited with faeces of man, dog, horse, cow and fowl, others baited with banana and tomato and some unbaited were exposed for six days in September–October in a tomato field in Maryland. In five daily counts of the catch, 553 and 571 adults of *Drosophila* (of which 96 per cent. were *D. melanogaster* Mg. and 2 per cent. *D. affinis* Sturt.) were taken in the traps baited with banana and tomato respectively, but none in any of the other traps. The tomato ceased to be attractive once decay had set in. *D. repleta* was not present, and had not been collected about tomatos in Maryland during the two preceding years.

Incho (H. H.). **A rapid Method for obtaining clean House Fly Pupae.**—*J. econ. Ent.* **47** no. 5 pp. 938–939, 1 fig., 5 refs. Menasha, Wis., 1954.

Various ways of separating pupae of *Musca domestica* L. from the rearing medium are briefly reviewed, including the use of the air separation apparatus described by Goodhue & Linnard [*R.A.E.*, B **38** 210]. A modification of this method is described in which the need to sift and dry the medium is obviated by the addition of vermiculite to the culture jars. Vermiculite is a light micaceous mineral expanded into small aggregates composed of thin plate-like particles. It is non-abrasive and alkaline and apparently absorbs enough water from the medium to provide optimum moisture for pupation. The larvae are reared by the Peet-Grady method [**37** 89] except that 800–1,000 cc. water are added per 340 gm. dry medium instead of 750 cc. When most are full grown and near the surface, a layer of vermiculite about 2 ins. thick is put over the medium. The larvae rapidly migrate into this drier and cooler layer, which is removed after 1–2 days and stored until all the larvae in it have pupated. The vermiculite is then removed with the cyclone separator, or the pupae can be sifted out or separated in an air blast.

Champlain (R. A.), Fisk (F. W.) & Dowdy (A. C.). **Some Improvements in rearing Stable Flies.**—*J. econ. Ent.* **47** no. 5 pp. 940–941, 2 refs. Menasha, Wis., 1954.

In this modification of a method recently described for rearing *Stomoxys calcitrans* (L.) [*R.A.E.*, B **42** 7], a moist cellulose sponge in a Plexiglas box was placed in a front corner of the fly cage, as it was found that the flies would oviposit on it rather than on the blood-soaked cellucotton in the feeding dishes [*loc. cit.*] and it was much easier to remove the eggs from it. Each morning, the sponge was transferred to a dish containing a little water, and the eggs were flushed out by squeezing, allowed to settle on the bottom of the dish and transferred to a tube by means of a medicine dropper, after most of the water had been poured off. They were then suspended in water and poured over the standard culture medium [**37** 89] in a plastic jar, and a half-inch layer of sand was added next day to discourage the growth of mould [**43** 26]. As the larvae would not pupate in the sand if it was dry, but pupated on the surface if it was moist, it was kept moist from the seventh day after the introduction of the eggs until the first adults emerged. It was then removed, and the puparia were separated from it by flotation and transferred to the fly cage. Mating and oviposition were stimulated by the use of an ultraviolet sun-lamp. Satisfactory oviposition and egg viability were obtained when 4,000 flies were kept in a cage measuring 14 × 12 × 12 ins., but larger cages were more convenient to service. Eggs immersed in

water and dry pupae were successfully kept for one and two weeks, respectively, at 12°C. [53·6°F.]. About 50 per cent. hatching and good emergence followed.

Shaw (F. R.) & Hovey (C. L.). **An Infestation of the European Hen Flea in Maine.**—*J. econ. Ent.* **47** no. 5 pp. 942–943. Menasha, Wis., 1954.

Fleas that were breeding in great numbers in the litter in a hen house in Maine and, in addition to attacking the fowls, bit anyone who went into the house, were identified as *Ceratophyllus gallinae* (Schr.). The infestation was brought under control by applying a dust containing 5 per cent. DDT to the litter at 1 lb. per 100 sq. ft.

Vincent (L. E.), Lindgren (D. L.) & Krohne (H. E.). **Toxicity of Malathion to the Northern Fowl Mite.**—*J. econ. Ent.* **47** no. 5 pp. 943–944. Menasha, Wis., 1954.

Six hens infested to varying degrees by *Fonsecaonyssus* (*Bdellonyssus*) *sylviarum* (C. & F.) were freed from infestation in one day by treatment with 4 per cent. malathion dust, applied by hand or with a puff duster into the feathers round the vent and breast, and remained free of mites when kept in cages for 28 days. In subsequent experiments, the puff-duster treatment gave effective control on large numbers of birds in cages, and fowls thoroughly dusted with 25 per cent. malathion were not harmed by it. Tests were then carried out with flocks in which most of the fowls were infested to compare the effectiveness of 40 per cent. nicotine sulphate (1 : 10 mix) applied by the drop method to each bird, 4 per cent. malathion dust broadcast by hand on the litter at 1 lb. per 20 sq. ft. and mixed with the nesting material, and the two methods combined. Percentage infestations on representative samples of birds were observed weekly for six weeks. The nicotine sulphate was not effective for long, presumably because the birds were re-infested by mites from the litter and nests. The malathion treatment kept percentage infestation low for the six weeks, although no application was made directly to the birds. Much the best control was given by the combination of the two treatments, which resulted in no infested birds being found until the last observation, when about 1·2 per cent. were infested. The inclusion of 50 parts malathion per million in the diet of 25 hens did not taint their eggs.

Smith (W. W.). **The Abundance and Distribution of the Ectoparasites of the House Mouse in Mississippi.**—*J. Parasit.* **41** no. 1 pp. 58–62, 1 map, 12 refs. Lancaster, Pa., 1955.

The ectoparasites found on over 1,300 mice [*Mus musculus*] trapped alive in indoor habitats in various parts of Mississippi during a one-year survey in 1949–50 comprised *Polyplax spinulosa* (Burm.), four species of fleas and at least 15 species of mites. The abundance and distribution of each are indicated. Over 80 per cent. of the mice were infested by mites, and about 10,000 mites were identified, but they did not include *Allodermanyssus sanguineus* (Hirst), the vector of rickettsialpox. Only 1·7 per cent. of the mice were infested by *P. spinulosa* and 2·7 per cent. by the fleas, which comprised *Xenopsylla cheopis* (Roths.), *Leptopsylla segnis* (Schönh.), *Nosopsyllus fasciatus* (Bosc), and *Echidnophaga gallinacea* (Westw.), and the average numbers of lice and fleas per infested mouse were 1 and 1·6; all these insects are common ectoparasites of rats and had probably spread to the mice from them.

Davis (G. E.). **Observations on the Biology of the Argasid Tick** *Ornithodoros puertoricensis* **Fox.**—*J. Parasit.* **41** no. 1 pp. 76–79, 2 refs. Lancaster, Pa., 1955.

Observations on the bionomics of *Ornithodoros puertoricensis* Fox [*cf. R.A.E.*, B **39** 35] were made on a colony established at Hamilton, Montana, from larvae and nymphs received from Porto Rico in 1946. The ticks were kept at room temperature and a relative humidity of 79 per cent. Pairing took place after the females had engorged, and the time between engorgement and oviposition was 7–26 days. A second oviposition sometimes followed, just after the first batch of eggs had hatched, without further feeding or mating. The numbers of eggs and (in brackets) larvae produced at first and second oviposition by three females were 249 (168) and 426 (332), 140 (133) and 352 (343), and 182 (174) and 108 (96); the female that laid fewer eggs at second than first oviposition did not feed or mate between them, whereas the other two did both. The egg and larval stages lasted 13–22 and 4–10 days, the larvae requiring 4–8 days to engorge on guineapigs, and the first (non-feeding), second and third nymphal stages lasted 16–31, 17–20 and 20–48 days, respectively. Of 22 third-stage nymphs, 12 males and one female moulted to adults, and nine females moulted to fourth-stage nymphs, all of which moulted to adults after 23–55 days. Ticks fed as larvae in October 1946 were still alive in the adult stage in May 1954.

Relapsing fever has not been recorded from Porto Rico, and spirochaetes have not been recovered from *O. puertoricensis*. The ticks have fed readily on man accidentally exposed in the laboratory. In experiments with a batch of ten ticks of each species that had fed on infected mice as second-stage nymphs, *O. dugesi* Mazzotti transmitted *dugesi* spirochaetes and a Kansas strain of *O. talaje* (Guér.) transmitted Kansas *talaje* spirochaetes, but *O. puertoricensis* transmitted neither. This indicates a marked biological difference between the three ticks. *O. puertoricensis* and ticks identified as *O. talaje* from Colombia interbred in the laboratory and produced fertile progeny. This is of interest as Fox suggested that the tick known as *O. talaje* in Panama might be *O. puertoricensis* [*loc. cit.*].

Whiting (F.), Nelson (W. A.), Slen (S. B.) & Bezeau (L. M.). **The Effects of the Sheep Ked (*Melophagus ovinus* L.) on Feeder Lambs.**—*Canad. J. agric. Sci.* **34** no. 1 pp. 70–75, 10 refs. Ottawa, 1954.

Experiments were carried out at Lethbridge, Alberta, during the winter feeding periods of 1950–51, 1951–52 and 1952–53 to determine the effect of the sheep ked (*Melophagus ovinus* (L.)) on weight gains and wool production of lambs that were being fattened, and the influence of nutrition on the ked population. Three groups of lambs were used in each season. One was free of keds and two fairly heavily infested, and one infested group received poor rations and the other two groups good rations. In each of the three years, there was no significant difference in weight gains or wool production between the groups receiving good rations, and no significant correlation within the infested groups between the numbers of keds on individual lambs and their weight gains [*cf. R.A.E.*, B **40** 192; **41** 73, 139]. Ked populations (estimated by 5-minute counts [**43** 131]) increased more rapidly and became larger on the poorly-fed lambs than on the well-fed ones. They increased on both groups during the first 2–3 months of feeding and then declined. Preliminary information indicates that the ked population on pregnant ewes continues to increase throughout the winter and spring months. No relationship was found between the number of keds on sheep and certain blood constituents or the suint and fat content of the fleece.

KARTMAN (L.). **Studies on *Pasteurella pestis* in Fleas. I. An Apparatus for the experimental Feeding of Fleas.**—*Exp. Parasit.* **3** no. 6 pp. 525–537, 3 figs., 32 refs. New York, N. Y., 1954.

An apparatus is described that has been designed for the *in vitro* feeding of fleas. It is based on the principle of transferring controlled thermal gradients from a water bath to a metal dish containing a liquid upon which fleas are allowed to feed through an animal-skin membrane; the membrane is fixed over the bottom of a tube containing the fleas and is in direct contact with the fluid. The feeding is accomplished in a "thermostabiliser," made of brass parts, which transfers the heat to the liquid food, maintains a constant thermal level, and allows the skin membrane to maintain contact with the food.

Heparinised blood at a temperature of 37°C. [98·6°F.] was used in a series of test feedings. In the first of these, with *Xenopsylla cheopis* (Roths.) and skin and blood of an immature rat (*Rattus norvegicus*) and with *Malaraeus telchinum* (Roths.) and skin and blood of its usual host (*Microtus californicus*), about 84 and 80 per cent. of the fleas, respectively, fed. In further experiments with *X. cheopis* and fresh blood of *R. norvegicus*, 59·3 and 65·8 per cent. fed through skins of young rats (*R. norvegicus*) and house mice (*Mus musculus*), respectively, as compared with only about 10 per cent. through skins of adults of either. Skins of certain small species of field rodents were also favourable. These results indicate that the thickness of the membrane is probably a critical factor. Heparinised blood and feeding tubes with the skin membranes on them were both stored in a deep freeze without affecting the response of the fleas to them. Blood that had been frozen for 35 or 60 days was as attractive as fresh blood when the skin membrane used for comparison was of a favourable kind, though the fresh blood appeared to be relatively the more attractive when the skin membrane was less favourable. Skins were successfully used when they were 120 days old and had been thawed and refrozen for as many as 12–15 separate feedings.

Some additional observations are recorded in an addendum. When very thin cellophane was used as the feeding membrane with fresh blood of *R. norvegicus*, none of 100 starved individuals of *X. cheopis* fed, whereas 68 out of 107 control fleas fed avidly through a skin of *Microtus californicus*. Both species of fleas fed readily on a commercial preparation of human blood used for transfusions. This whole blood contains 1·32 gm. sodium citrate, 0·48 gm. citric acid and 1·47 gm. dextrose per 100 cc., and its availability obviates the time-consuming procedure of bleeding animals.

TRAUB (R.), HERTIG (M.), LAWRENCE (W. H.) & HARRISS (T. T.). **Potential Vectors and Reservoirs of Hemorrhagic Fever in Korea.**—*Amer. J. Hyg.* **59** no. 3 pp. 291–305, 5 figs., 12 refs. Baltimore, Md., 1954.

When this paper was written, over 2,000 cases of haemorrhagic fever had occurred among United Nations troops in Korea since the spring of 1951. Its incidence has consistently shown two seasonal peaks, in May–June and October–November, and the epidemic area extends northwards from Seoul, very few cases having been reported from the southern part of the peninsula. The disease has also been encountered by the Japanese in Manchuria and by the Russians in Siberia and called by them epidemic haemorrhagic fever and haemorrhagic nephroso-nephritis, respectively. They believe that it has an arthropod vector and a wild rodent reservoir. [They also believe that the causal agent is a virus and have infected man with it experimentally; it has

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never been isolated in laboratory animals or in culture.] Definite information on transmission cannot be obtained in the absence of a satisfactory laboratory host, but investigations in Korea in 1952 indicated that the vectors were probably ground-inhabiting arthropods of limited mobility. There was hardly ever any history or sign of insect bite. Cases were usually isolated, but 10 per cent. occurred in small outbreaks. There were no secondary cases.

More intensive studies were made from May 1952 to January 1953 in three circumscribed areas in which outbreaks had occurred in 1951 and 1952. Attempts were made to collect all types of rodents and insectivores, but attention was concentrated on *Apodemus agrarius mantchuricus*, *Microtus fortis pelliceus*, *Clethrionomys rufocanus regulus* and *Cricetulus triton nestor*, which were abundant and had many ectoparasites. Immature Ixodid ticks were collected 33 times on small rodents, but there were no records of ticks on man, and the group did not appear to warrant further consideration. Fleas were taken occasionally, but their scarcity and a lack of marked seasonal variation in their abundance made them unlikely vectors. Laelaptid mites, of which the most abundant was *Laelaps jettmari* Vitzthum, were fairly common, but their seasonal incidence was erratic with no marked peaks in spring and autumn for the group as a whole or any one species. There is an unpublished record by Japanese workers of the isolation of the causal agent of haemorrhagic fever from *L. jettmari* as a result of inoculating man with a suspension of 203 examples of this mite collected from about 40 of *A. agrarius mantchuricus* in Manchuria, but none of the Laelaptids collected in Korea is known to bite man, and most, including *L. jettmari*, apparently do not feed on the blood of the rodents on which they are found. They were as common in camps apparently free of infection as in the endemic area. They might serve as vectors in circumstances that bring troops into close contact with rodents and their nests, but do not appear to fit the observed epidemiological pattern as a whole.

Trombiculid larvae, on the other hand, showed a striking seasonal periodicity with peaks in spring and autumn. The average number of all species per host on *Apodemus*, estimated from examinations of over 1,000 examples of this rodent in the three areas, was 15 for the first two weeks of May, dropped rapidly till it was less than 1 in July and August, and then rose to 30 in late September and to a maximum of 80 in mid-October. It remained high through November but fell rapidly during December and was 11·3 in mid-January. The same general seasonal trend was shown on *Microtus*. *Clethrionomys* and *Cricetulus* were collected too infrequently to warrant calculation of averages, but the numbers of Trombiculids on them were again lowest in summer. The sharp decrease in June was followed by a decline in haemorrhagic fever in July and the increase that began in late August and reached a peak in October was followed by the rise in cases from September to a peak in November. In 1953, the Trombiculid population, which was very low in January and February, increased rapidly in March to a peak in April and declined sharply in June. The spring outbreak of the disease began in April and reached a peak in late June or early July.

The commonest Trombiculids were *Trombicula pallida* Nagayo et al., *T. orientalis* Schluger, *T. tamiyai* Philip & Fuller and *T. palpalis* Nagayo et al. *T. orientalis* comprised 7 and 24 per cent. in October and November, respectively, but *T. pallida* comprised 40 per cent. in October and was far the most abundant species in spring. It was the species that most closely fitted the incidence of the disease with allowance for incubation. The four rodents studied had essentially the same Trombiculid fauna, though certain of the species were more frequent on some hosts than others. The same species of Trombiculids were taken in all three infested areas.

MacNay (C. G.). **New Records of Insects in Canada in 1952: a Review.**—*Canad. Ent.* **86** no. 2 pp. 55–60, 7 refs. Ottawa, 1954.

The numerous arthropods recorded from Canada for the first time in 1952 included *Musca autumnalis* Deg., which occurred in Nova Scotia [*R.A.E.*, B **43** 55], and *Argas reflexus* (F.), which was found with other ticks in a bird's nest in British Columbia.

Bigelow (R. S.) & Reimer (C.). **An Application of the Linear Discriminant Function to Insect Taxonomy.**—*Canad. Ent.* **86** no. 2 pp. 69–73, 5 refs. Ottawa, 1954.

The insects used in this study were two closely related species of grasshopper that are difficult to distinguish from each other. Measurements of five characters were made on 36 males of each species, from which were calculated their mean values and the standard deviations, and significant differences between the two species were found in the means of four of the characters. On the assumption that the mid-point between the specific means is the critical value for a particular character, a specimen would be misdetermined if its measurement differed from the mean of the species to which it did not belong by less than half the difference between the specific means. The probability of misdetermination is obtained by calculating t, equal to half the difference between the specific means divided by the standard deviation, and referring it to the normal probability integral table. The discriminating precision of the four characters separately ranged from 77 to 88 per cent.

Greater precision was obtained by combining two or more characters in a linear discriminant function, expressed as $z = a_1 X_1 + a_2 X_2 + \ldots$, where X_1, X_2 . . . represent the characters measured and a_1, a_2 . . . are appropriate weighting factors [which can be calculated from measurements on specimens that have been correctly determined]. When three characters (femur length, femur width and interocular space) were combined in such a function, individual males of either species could be determined with a discriminating precision of 98 per cent.

It is concluded that the use of discriminant functions may increase the speed and accuracy of determinations by inexperienced workers, facilitate the detection of small morphological differences, especially those concerned with the shape of structures or with characters that are widely separated spatially, and provide a method for the objective analysis of intraspecific variation [*cf.* next abstract].

Bigelow (R. S.) & LeRoux (E. J.). **Distinct morphological Differences between DDT-resistant and non-DDT-resistant Strains of the House Fly, *Musca domestica* L.**—*Canad. Ent.* **86** no. 2 pp. 78–86, 5 figs., 11 refs. Ottawa, 1954.

The morphological differences between DDT-resistant and DDT-susceptible strains of *Musca domestica* L. that have been detected in studies concerned with structural characters directly related to the absorption of the insecticide [*cf. R.A.E.*, B **37** 217; **39** 84] have been very small. Morphological characters may, however, be genetically linked with physiological ones with which they have no apparent functional correlation, and the possibility of such a linkage with resistance to DDT in *M. domestica* was accordingly investigated. Examination of a resistant strain (Beltsville) that had been reared for many generations in a DDT-painted cage and a susceptible one (Macdonald) reared for three years in a DDT-free environment revealed the

existence of several morphological differences, and four characters were measured. These were the maximum width and maximum length of the second abdominal sternum (X_1 and X_2, respectively), the width of the frons between the ptilinal sutures at the level of the boundary between the second and third antennal segments (X_3), and the length of the terminal segment of the right antenna measured along the anterior surface (X_4). Statistical analysis showed that the means of X_2 were similar in the two strains, but that the means of X_1 and X_3 differed markedly between them. If the samples used were representative, it can be stated with 99·9 per cent. confidence that the true difference in X_1 between the strains is greater than 0·146 mm. X_1 would exceed 0·609 mm. (the mid-point between the strain means) in 95 per cent. of the Beltsville flies and fall short of it in 95 per cent. of the Macdonald flies, and X_3 would exceed 0·590 mm. in 85 per cent. of the former, and fall short of it in 85 per cent. of the latter.

These two strains were then compared with seven others, but, owing to overall differences in strain size, the comparison was based on ratios instead of direct measurements. The ratios were X_5 ($= X_1 : X_2$) and X_6 ($= X_4 : X_3$). The additional DDT-resistant strains were Super Pollard, which is also resistant to γ BHC [**41** 74] and Super Bellflower [*cf.* **38** 156]. The others were Methoxychlor (a strain resistant to methoxy-DDT), California and Mayo (DDT-susceptible strains from California and Ontario), a Wilson strain from Rutgers University that was resistant eight years before but had not been subsequently exposed to DDT and, in view of the rapid loss of resistance noted in some other strains, was regarded as susceptible, and wild flies collected in a dairy barn in Quebec of which the degree of resistance was unknown and which were also considered to be susceptible. The strain samples consisted of 15 males and 15 females for all strains except Mayo, of which there were 15 females only, and the wild flies of which there were 25 of each sex. X_5 was measured for all strains and X_6 for all except the Wilson strain and the wild flies. The results are given in tables and graphs, together with the analyses of variance.

The strains differed markedly from each other in both X_5 and X_6, and the difference between the resistant and susceptible groups formed the major part of the overall difference, though differences between resistant strains were considerable. There was no significant difference between strains California and Macdonald, or, in X_5, between these and Methoxychlor or Mayo. The mean for X_5 was greater than 1 in each of the three DDT-resistant strains and less than 1 in each of the other six. The mean for strain Methoxychlor was somewhat higher than those of the other susceptible strains but significantly lower than that of the most similar of the resistant strains, and it is shown from the data given that the mean X_5 of samples of the sizes used would enable any of these strains to be classified as DDT-resistant or susceptible with a precision, for practical purposes, of 100 per cent. There was no significant sex difference in X_5, except in the Pollard and Bellflower strains, in which the mean for males was slightly the lower.

The means for X_6 differed with sex as well as with strain, but the sex differences (which were probably mainly due to the normal tendency of the eyes to be wider apart in the females) were of the same order in all the six strains examined. The means for a given sex were lowest in the resistant strains and lower for California and Macdonald than for Methoxychlor. In the females, the mean difference between Bellflower and Macdonald was significant at the 5 per cent. level, and all other mean differences between DDT-resistant and susceptible strains were significant at 1 per cent. In the males, the means for Bellflower, California and Macdonald were of the same order, Pollard differed from California and Macdonald at the 5 per cent. level

and Beltsville differed from Bellflower and Pollard at 5 per cent. and from the susceptible strains at 1 per cent.

Since X_5 and X_6 were similar in all susceptible strains, regardless of their place of origin, the consistent differences in these characters between the resistant and susceptible groups are not due to geographical variation. The three resistant strains form a single, distinct group on the basis of similarities in X_5 and X_6, which strongly indicates that these similarities had a common origin and did not arise solely by chance. It appears certain that at least some of the genetic factors responsible for the differences in X_5 and X_6 between the two groups are associated with those producing resistance to DDT [*cf.* **42** 7]. Beltsville differed more distinctly from the susceptible strains in both X_5 and X_6 than did the other two resistant strains, and probably possesses more of the genetic factors involved in producing the differences in these characters; it is not necessarily more resistant, however, since it is likely that some of the factors for DDT resistance are not genetically associated with the morphological characters and, furthermore, that the latter may not be associated with the genes that produce the highest degree of resistance.

Two combinations of the characters used are expressed in linear discriminant functions [see preceding abstract]. The discriminating precision of the function given by X_1, X_2 and X_3 for individuals of either sex of the Beltsville and Macdonald strains was 98 per cent., as compared with 95 or 85 per cent. for X_1 or X_3 alone. X_5 and X_6 were combined in a function based on random samples of five females from each of the three resistant and three of the susceptible strains, and its discriminating precision for individual females of the two groups was 90 per cent., as compared with 76 or 85 per cent. for X_5 or X_6.

Buxton (P. A.). **The Natural History of Tsetse Flies. An Account of the Biology of the Genus *Glossina* (Diptera).**—*Mem. Lond. Sch. Hyg. trop. Med.* no. 10, $9\frac{3}{4} \times 7\frac{1}{4}$ ins., xviii + 816 pp., 47 pls., 165 figs., 27 pp. refs. London, H. K. Lewis & Co. Ltd., 1955. Price £4 4*s.*

This comprehensive account of knowledge of the flies of the genus *Glossina*, the principal aim of which is to describe the relations between them and their environment, is based on field experiments and observations, supplemented by the results of laboratory investigations. These support one another to a remarkable degree. As differences between species have been found to be generally small and only relative, the various topics dealt with are usually discussed with regard to the genus as a whole, so that the information on the individual species is integrated in relation to subjects. These include adult morphology and the systematic position of the genus and its subdivisions (with a modification of Smart's key to species and regional field keys by H. S. Leeson); the structure and biology of the third-stage larva and puparium (with Swynnerton's key for the identification of puparia of seven East African species); anatomical and functional aspects of feeding, digestion and excretion; metabolism; sense organs, the method of locating the host, behaviour on and after alighting, and the proportion of the sexes attracted to man; reproductive organs, fertilisation and the reproductive cycle in the female, the breeding season in nature and choice of breeding sites; movement and rest; and causes of death in the various stages.

A chapter on sources of food includes a survey of the food of various species. Individual species are also considered at some length in chapters on geographical distribution and the effect of climate on distribution, activity and seasonal abundance, and in one on tsetse and vegetation. This

includes a survey of types of African vegetation and discussion of relationship to vegetation in certain species and the genus as a whole and the effect of man's intervention on vegetation and on the ecology of *Glossina*. Populations are considered in a chapter dealing with methods of studying them and their structure, growth and decline. The longest single chapter is that devoted to control and is divided into sections on measures directed against the puparia, the adults, the food supply of the latter and the vegetation, and on the effects of human settlement, and includes a summary of the results obtained by some of the methods. Finally, there are two chapters on the relation of tsetse to trypanosomes and to the diseases of man and domestic animals for which these are responsible. Ten appendices deal mainly with various study methods. An index by W. H. Potts occupies some 50 pages.

Gressitt (J. L.). **Insects of Micronesia. Vol. 1. Introduction.**—viii + 257 pp., 49 figs., 22 maps, 9 pp. refs. Honolulu, Bishop Mus., 1954.

Esaki (T.), Bryan jr. (E. H.) & Gressitt (J. L.). **Vol. 2. Bibliography.** —ii + 68 pp., 1 map. 1955.

These are the first two volumes of a work to which over 115 authors are to contribute and which will comprise a survey of the insects and almost all the other terrestrial arthropods of Micronesia. The area concerned includes the islands of the Mariana, Caroline, Marshall, Gilbert, Bonin and Volcano groups and also Ocean, Nauru, Wake and Marcus Islands. The treatment is to be primarily systematic, but information on immature stages, habits, ecology and economic importance is to be included. The first two volumes are to be followed by two on arthropods other than insects, 15 on the insects, and one comprising a general summary of the fauna in which zoogeography and speciation will receive special emphasis. Each is to have its own index.

The introductory volume contains descriptions of the area, its geology, climate, flora and fauna, accounts of insect ecology on the atolls and high islands, a section on economic entomology, notes on collecting work done by various investigators, a bibliography of the literature cited, a list of Micronesian place names showing geographical position, and a general index. The section on economic entomology is mainly devoted to pests of crops, but includes a brief survey of arthropods of medical or veterinary importance.

The second volume comprises a bibliography of Micronesian entomology, with an indication of papers referring to new species, and includes a list of the Japanese publications cited and an index to subjects with references to pertinent papers in the bibliography.

Bekker (P. M.). **A Blue Tick resistant to B.H.C., but not to Arsenic.**—*Fmg in S. Afr.* **28** no. 325 pp. 119–120, 136, 9 refs. Pretoria, 1953.

It was found about ten years ago that a strain of *Boophilus decoloratus* (Koch) in South Africa that had become resistant to the arsenical dips formerly successfully used against the species could be controlled by BHC [*R.A.E.*, B **37** 209–210, etc.]. This was at first added to the arsenical dips and later used alone. The concentration prescribed in 1947 was 100 parts γ isomer per million, but this was not effective against ticks of other species and it was soon found that the arsenic-resistant strain of *Boophilus* had become highly resistant to BHC also [**40** 108]. A dip concentration of 300 p.p.m. γ isomer was legalised in January 1952, but many complaints of the inefficiency of BHC dips were subsequently received, even from areas outside the eastern coastal belt, where the arsenic-resistant strain is present.

An investigation was made in 1953 on a farm in the Pretoria district on which cattle ticks were at one time well controlled by arsenical dips but BHC dips had been used instead for five years. Weekly dipping ceased to give effective control of ticks, especially *B. decoloratus*, towards the end of 1952, and 15 cows that had been subsequently dipped twice in an arsenic wash and were reasonably free from *Boophilus* were used to compare the effects of three treatments applied weekly for five weeks, beginning on 17th March 1953. The treatments were wettable-powder suspensions containing 0·03 per cent. γ BHC or 0·3 per cent. p,p′DDT applied as sprays at 2 gals. per animal, and a dip containing 0·16 per cent. As_2O_3 (and 100 p.p.m. γ BHC). By 14th April, the five cows treated with DDT were free of *B. decoloratus* except for two adults on one animal, and the five dipped cows bore larvae only, whereas all stages were present in large numbers on the five treated with BHC. Thus, a strain has developed that is markedly resistant to BHC, but would apparently be easily controlled by arsenic.

Lowman (M. S.), Gersdorff (W. A.) & Mitlin (N.). **Pyrethrum Flower Toxicants. . .**—*Soap & chem. Spec.* **30** no. 8 pp. 139, 141, 143, 145, 159, 3 refs. New York, N. Y., 1954.

Pyrethrum flowers fermented in closed containers for six days or four, six or 12 months before being dried were found both by chemical tests and by spray tests against *Musca domestica* L. to retain more pyrethrins during storage for 34–58 months than controls dried at room temperature without previous fermentation.

Gillett (J. D.). **Variation in the Hatching-response of *Aëdes* Eggs (Diptera: Culicidae).**—*Bull. ent. Res.* **46** pt. 2 pp. 241–254, 2 figs. 11 refs. London, 1955.

The following is the author's summary. Eggs of *Aëdes* do not necessarily hatch on becoming mature, even though conditions are known to be compatible with hatching. Even the eggs laid by a single female in a single batch and kept submerged in a single container may hatch in instalments over a very long period and, although on one occasion a high proportion of the eggs may hatch within a given period, on another, for no apparent reason, very few may hatch.

The problem of erratic hatching has been studied here mainly in *Aëdes africanus* (Theo.) and *A. aegypti* (L.). It is considered that mature eggs enter a state of diapause, the depth of which varies with the passage of time, and that the manner of this variation with time itself varies from egg to egg. Different batches of eggs laid by females of the same species vary in the proportion of the different kinds of egg present.

Variation in response of the eggs has been studied by the application of a suitable hatching-stimulus in equal daily doses. The stimulus used was sufficiently weak to allow variation in response to be manifested, but sufficiently strong to outweigh uncontrolled variables in the environment.

Tests were made of certain variables which occur between females and between the eggs laid in a single batch, and which might conceivably influence the hatching-response of the eggs. It was shown that the following may be excluded as having any influence on the subsequent hatching-response of the eggs: the orientation of the eggs with respect to gravity; small differences in age at the time of submergence; the order in which the eggs in a batch are laid; the number of blood-meals taken by the mother during pregnancy; and the number of matings by the mother before the first

blood-meal. Inconclusive results were obtained about the influence of the amount of some hypothetical substance laid with the eggs by the mother.

It is suggested that variation in the hatching-response of *Aëdes* eggs has an inherited basis [see next abstract].

GILLETT (J. D.). **The inherited Basis of Variation in the Hatching-response of *Aëdes* Eggs (Diptera: Culicidae).**—*Bull. ent. Res.* **46** pt. 2 pp. 255–265, 5 refs. London, 1955.

The following is the author's summary. A stimulus is necessary for the hatching of eggs of *Aëdes* mosquitos, but, while many different kinds of change in the external environment may be adequate as hatching-stimuli, there is variation in the response of the eggs to any given one of them.

Not only is there variation between species as regards behaviour of the eggs, but batches of eggs laid by different females in a single species may vary one from another and there is even variation of behaviour between the eggs laid in a single batch.

The response of the eggs of *A. aegypti* (L.) has been studied here and evidence produced that both parents contribute to their hatching-behaviour. Egg behaviour has also been studied in two populations of this species, one originating from West Africa and the other from East Africa. In the former, only a very low proportion of the mature eggs (0–9 per cent.) responded to the daily application of a suitable stimulus over a short period, whereas in the latter the proportion of responders in the same period with the same stimulus was very much higher (46–100 per cent.). The next generation reared from each of these gave very similar results (0–11 and 65–100 per cent., respectively), while reciprocal crosses between them gave a wide range of scatter (16–100 and 4–99 per cent., respectively).

It is concluded that hatching-behaviour of the eggs in *A. aegypti* is mainly inherited. It appears that the mature eggs enter a state of diapause, the depth of the diapause and its changes with time being determined by factors contributed by both parents.

The advantages of variation in response to a hatching-stimulus are pointed out. Delayed or erratic hatching is widespread in the genus and its seems probable that similar mechanisms are involved, actual differences in hatching-behaviour between populations or between species being determined by isolation and selection.

LAIRD (M.). **Mosquitos and Malaria in the Hill Country of the New Hebrides and Solomon Islands.**—*Bull. ent. Res.* **46** pt. 2 pp. 275–289, 3 figs., 23 refs. London, 1955.

The following is almost entirely the author's summary. *Anopheles farauti* Lav. is recorded from the upper reaches of the Nevaka river, south-western Espiritu Santo, New Hebrides, to an altitude of 1,100 ft. and a distance of 12 miles from the coast [*cf. R.A.E.*, B **34** 122]. The presence of *Plasmodium vivax* and *P. malariae* in children from hill villages with no nearby Anopheline larval habitats is noted. These children, most of whom have never visited the coast, become exposed to infection during prawning trips to the valleys below their homes. *P. vivax* and *P. malariae* are shown to be transmitted in the interior of Guadalcanal, British Solomon Islands Protectorate, where *A. punctulatus* Dön., a proved vector of malaria, breeds at altitudes of up to at least 1,900 ft. above sea level. *A. solomonis* Belkin, Knight & Rozeboom, the status of which as a vector is unknown, was found breeding at an altitude of 3,000 ft. [*cf.* **35** 161]. Neither *P. falciparum* nor *Wuchereria bancrofti* was recorded from the hill districts visited. During

the investigations, several species of mosquitos of other genera were collected. Features of the larval morphology of some of these and of *A. solomonis* and *A. punctulatus* are illustrated and briefly discussed in a systematic appendix. Characters distinguishing the larvae of *A. solomonis* from those of the closely related *A. lungae* Belkin & Schlosser, which occurs at lower altitudes in Guadalcanal, are also noted.

LAIRD (M.). **Notes on the Mosquitos of the Gilbert, Ellice and Tokelau Islands, and on Filariasis in the latter Group.**—*Bull. ent. Res.* **46** pt. 2 pp. 291–300, 1 fig., 17 refs. London, 1955.

The literature on mosquitos and filariasis in the Gilbert, Ellice and Tokelau Islands is reviewed, and the results of investigations made during very brief visits to them are recorded. Filariasis in the Tokelau and Ellice Islands, which are Polynesian, is caused by the non-periodic form of *Wuchereria* [*bancrofti*], but there is evidence that the nocturnal form may be present as well in the Gilberts, which are in effect a bridge between Polynesia and Micronesia, the Gilbertese themselves being largely Micronesian. The mosquitos present in the Gilbert Islands are *Culex pipiens fatigans* Wied., *C. annulirostris* Skuse, *Aëdes marshallensis* Stone & Bohart, *A. aegypti* (L.) and *A. vexans nocturnus* (Theo.); all but the first were found by the author and *C. annulirostris* and *A. v. nocturnus* are new records for the Group. These two and *A. aegypti* were also found, and had previously been recorded, in the Ellice Islands. The only other mosquito known to be present in any of the islands is *A. polynesiensis* Marks, the widely distributed vector of *Wuchereria* in Polynesia [*cf. R.A.E.*, B **41** 161]. It was not found in the Gilberts, but its presence in the Ellice Islands [*loc. cit.*] was confirmed and it was the only mosquito in the Tokelau Group. The microfilaria rate found at Nukunono in the Tokelau Group in June 1953 was 27·9 per cent. in 43 males and 9·3 per cent. in 54 females of all ages.

Notes are given on the breeding places of the mosquitos on the islands visited and on potential breeding places in which no mosquito larvae were found.

WHARTON (R. H.). **The Susceptibility of various Species of Mosquitos to DDT, Dieldrin and BHC.**—*Bull. ent. Res.* **46** pt. 2 pp. 301–309, 15 refs. London, 1955.

The following is virtually the author's summary. The susceptibility of various mosquitos to p,p′DDT, dieldrin and γ BHC has been studied. Adult females were exposed in small tubes lined with filter papers impregnated with insecticide-oil solutions. Larvae were exposed to insecticide-acetone suspensions in water. Adult mosquitos tested in London showed no striking differences in susceptibility to DDT, though the median lethal concentration (MLC) was greater for *Culex pipiens molestus* Forsk. (1·6 per cent.) than for *Aëdes aegypti* (L.) (0·9), *Anopheles maculipennis* var. *atroparvus* van Thiel (1), or *A. quadrimaculatus* Say (0·7). *C. p. molestus* and *Aëdes aegypti* showed the same order of susceptibility to dieldrin and BHC, with *Anopheles m. atroparvus* more susceptible to both insecticides.

Adult and larval mosquitos in Malaya varied considerably in their susceptibilities to DDT, dieldrin and BHC. Adults of *C. pipiens fatigans* Wied. showed a low degree of susceptibility to DDT (MLC>5 per cent.) and other species showed varying degrees of susceptibility, *Aëdes aegypti* (1·6), *A. albopictus* (Skuse) (1·3), *Mansonia longipalpis* (Wulp) (0·8), *M. uniformis* (Theo.) (0·5), *C. gelidus* Theo. (0·3–0·5) and *Anopheles maculatus* Theo. (0·4). *C. p. fatigans* (0·46) was readily killed by dieldrin, but was less

susceptible than *Aëdes albopictus* (0·23), *C. gelidus* (0·18), *M. longipalpis* (0·14), *A. aegypti* (0·13) or *M. uniformis* (0·12). Larvae of *C. p. fatigans* (MLC 0·145 parts per million) were also less susceptible to DDT than larvae of *A. aegypti* (0·008), *A. albopictus* (0·065) or *Anopheles maculatus* (0·026), but were more easily killed by dieldrin and BHC than the other species.

Under the conditions of these experiments, BHC was apparently the most toxic material to adults because of its fumigant properties. Dieldrin was more toxic than DDT to the adults of all species. Dieldrin was the most effective material against larvae; it was more toxic than BHC to all species and more toxic than DDT to all except *A. aegypti*. DDT was more toxic than BHC to the larvae of all species except *C. p. fatigans*.

It is suggested that, where possible, a median lethal concentration should be determined for the main species that are vectors of disease, wherever insecticide deposits are used, to serve as a basis for comparison when resistance is suspected.

Nash (T. A. M.). **The Fertilisation of *Glossina palpalis* in Captivity.**—*Bull. ent. Res.* **46** pt. 2 pp. 357–368, 1 graph, 5 refs. London, 1955.

In experiments on the rearing of *Glossina palpalis* (R.-D.) in Northern Nigeria, examination of the spermathecae of 532 females segregated from males within 24 hours of emergence showed that 3·8 per cent. were fertilised, though most males under 24 hours old are impotent. When males aged 2–8 days were forced to compete for females with older ones, it was found that young males must be 7–8 days old before their virility approaches that of older males. When virile males were put into mating cages containing virgin females, pairing began immediately and continued for 23 hours, the number of pairs decreasing steadily throughout the period. The cessation of copulation was due to the females' having become unwilling to pair and to their ability to repulse the males. Readiness to pair was restored in many females by feeding. There is no need to leave the sexes together for more than 24 hours, as excellent fertilisation is obtained in that time. Spermathecae of 900 females were dissected to determine the age at which females were most readily fertilised when put at the age of 1–10 days for 24 hours with twice their own number of virgin males 7–8 days old. Fertilisation was significantly greatest (84·4 per cent.) when females were three days old, and it was least (60 per cent.) when they were nine days old. Significantly more females were fertilised at 1–5 days than 6–10 days old, although there was only 64·4 per cent. fertilisation when the females were two days old. The average degree of impregnation among fertilised females was high and very similar (1·8 or 1·9) for all ages investigated. Complete impregnation of both spermathecae is represented by a value of 2.

The routine method of rearing adopted as a result of these findings is to place females three days old in a mating cage with old males in the proportion of 33:67 or 43:57. After 24 hours, the females are removed to Bruce boxes in each of which 20 females are kept with five young males. To ascertain the fertilisation rate achieved under these routine conditions, eight samples of 50 females each were removed on the 16th day of life, over a period of three months, and dissected. It was found that 88 per cent. were fertilised, only 8 per cent. less than has been observed in the field, and the percentage of males (67 or 57) made no appreciable difference. The value of young males in the Bruce boxes has not been proved, but it may increase the fertilisation rate, and allows re-fertilisation of old females, if necessary. The attractiveness to males of old females, and their willingness to be re-fertilised, was found to be very variable. In one experiment, females 65–71 days old were attractive but unwilling; in another, females at least

73 days old were attractive and fairly willing; in a third, females about 123 days old were not attractive. There was evidence that the reproductivity of females decreases considerably with age. It might therefore be advisable in breeding establishments to destroy the older females and get a quick turn-over of young, highly productive individuals.

Smith (A.). **The Transmission of Bancroftial Filariasis on Ukara Island, Tanganyika. I. A geographical and ecological Description of the Island with an annotated List of Mosquitos and other Arthropods of medical Importance.**—*Bull. ent. Res.* **46** pt. 2 pp. 419–436, 1 pl., 1 map, 3 refs. London, 1955. **II. The Distribution of Bancroftial Microfilaraemia compared with the Distribution of Hut-haunting Mosquitos and their Breeding Places.**—*T. c.* pp. 437–444, 1 pl., 1 map, 13 refs.

In the first part of this paper, a description is given of Ukara Island (Lake Victoria), including accounts of topography and climate, the people, their villages and huts [*R.A.E.*, B **43** 94] and their agriculture, which is of an advanced nature. There are also lists, with notes on abundance, of the mammals, reptiles and amphibia collected, and of mosquitos and other arthropods of medical importance. The mosquitos, which were collected as part of a study of the transmission of *Wuchereria bancrofti*, comprised 11 species of *Anopheles* and 27 of other genera (some represented by two varieties). The commonest species of *Anopheles* attacking man were *A. gambiae* Giles and *A. funestus* Giles, which bit mainly in huts and at night. Four out of 239 people examined were infested with *Pediculus humanus capitis* Deg. and 23 out of 123 huts were infested with *Ornithodoros moubata* (Murr.) and 15 of 20 with *Cimex hemipterus* (F.).

In the second part, the distribution of *W. bancrofti* in man is compared with that of *A. gambiae* and *A. funestus*. Of almost 6,000 specimens of night blood, 21 per cent. were positive for microfilariae. Infections occurred in all of 26 villages studied, but were numerous in some and comparatively scarce in others. Filarial infections were also found in blood taken by day from birds, hyrax, a dog and one species of lizard, but were not found in domestic fowls, cattle, goats, various other common mammals or frogs. To sample mosquito populations in huts, 140 huts in 14 villages were treated with pyrethrum spray in May 1953 and 100 huts in ten villages in July; the procedure of treatment and an experiment showing its reliability are described. The catches comprised 12,476 males and 40,207 females of *A. gambiae* and 30 males and 247 females of *A. funestus* in May, and 95 males and 2,104 females of *A. gambiae* and 24 males and 632 females of *A. funestus* in July, together with very small numbers of other mosquitos. Analyses of the catches according to locality indicated that villages situated in the irrigation areas, where rice and also a coarse fodder grass are grown, had high densities of *A. gambiae* and *A. funestus* and also high microfilaria rates in man. Low densities of *A. gambiae* and *A. funestus* were associated with low microfilaria rates.

Saliternik (Z.). **The specific biological Characteristics of** *Anopheles* (*Myzomyia*) *sergentii* (**Theo.**) **and their Correlation with Malaria Control in Israel.**—*Bull. ent. Res.* **46** pt. 2 pp. 445–462, 2 pls., 5 figs., 13 refs. London, 1955.

The following is partly based on the author's summary. *Anopheles sergentii* (Theo.) has long been considered to be the mosquito chiefly responsible for autumn transmission of *Plasmodium falciparum* in Israel and

is now the most important vector of malaria there, as the numbers of *A. maculipennis sacharovi* Favr and *A. superpictus* Grassi have been greatly reduced by the country-wide use of modern insecticides. Very brief notes are given on the morphology of the adults, larvae and eggs, including variations in the pigmentation of the fronto-clypeus in the larvae, which may have genetical significance. The resistance shown by the aquatic stages to extreme variations in environmental conditions and their ability to survive and even undergo metamorphosis in exceedingly small amounts of water are noted. Breeding in nature was found to occur at temperatures between 12 and 36°C. [53·6 and 96·8°F.]. At 30°C. [86°F.], the egg and pupal stages lasted 1–2 days each, and the total period from oviposition to adult emergence was nine days, whereas in winter it may be as much as three months. The egg stage lasted 13 days at 13°C. [55·4°F.] and the pupal stage ten days at 11·5°C. [52·7°F.].

In the field, the best conditions for breeding are found in shallow. temporary puddles and seepages and in gravel on the banks of wide, shallow streams, at temperatures between 23 and 28°C. [73·4 and 82·4°F.], a pH of 7–7·55 and a salinity up to 0·6 per cent. Most breeding places are partly shaded, either by stream banks or by vertical aquatic vegetation. Adult populations were largest from September to November with a peak in October.

The average numbers of eggs per batch were determined in observations in Haifa in 1939–40 as 112 for *A. sergentii*, 133 for *A. superpictus* and 198 for *A. m. sacharovi*. The numbers of eggs per batch were greatest when populations were most dense. Both larvae and adults of *A. sergentii* overwintered, females with a developed fat-body were never seen and ovipositing females or females with developing eggs can be found throughout the winter. The adults rest for choice in partly shaded corners of rooms and stables. For estimating their density and seasonal prevalence, trap shelters were devised that eliminated draughts and provided twilight illumination, suitable temperatures and appropriate isolated resting surfaces. They were made of wood or cardboard and set up in semi-darkness in barns and stables or in sheltered places outdoors. Some had no bottom or no front wall and were partly covered with sacking or lined with rough dark cloth. One such trap, well constructed and placed, attracted 80–90 per cent. of the total number of mosquitos caught in a given room. The traps (left untreated) provided an effective check on the presence and movement of Anophelines in settlements that had been sprayed with DDT. The mosquitos were most numerous in the traps between 8 and 10 a.m. but also entered them freely in the afternoon on cloudy days. They left about dusk. Adults dispersed in numbers to places as much as four miles from their breeding areas. The females rested and bit man and animals both indoors and out. If all sources of light in a room are darkened except for one closed window, all adults will fly to this window at twilight, or at any time if a pyrethrum aerosol is released in the room. This can facilitate the rapid collection of all adults present.

Notes are given on the macroscopic recognition of *A. sergentii* by observation of the pattern taken up by a few eggs on a drop of water [*cf. R.A.E.*, B **31** 68], by the appearance of the larvae and by the response of the latter to certain stimuli. Methods of control suited to the biological characteristics of the species are discussed. Measures against the larvae include drainage and filling of seepage and overflow pools, diversion of streams to dry the regular bed, and flushing of streams in conjunction with the application of oil containing 2–5 per cent. DDT. Treatment with insecticide deposits that is restricted to living quarters does not control the adults as they often rest in unfinished buildings, cellars, caves and other untreated places, and

extended treatment combined with regular measures against these larvae is considered necessary. All control measures are of greatest importance in the autumn.

Rageau (J.), Adam (J. P.) & Rivola (E.). **Étude préliminaire sur la biologie d'*Anopheles gambiae*, Giles 1902 dans les régions forestières du Sud-Cameroun.**—*Ann. Parasit. hum. comp.* **28** no. 5–6 pp. 425–449, 4 figs., 6 graphs, 41 refs. Paris, 1953.

To be successful in the control of malaria, a campaign against Anophelines must be based on precise knowledge of the bionomics of the vector species under local conditions, and such knowledge is particularly necessary where the vector is *Anopheles gambiae* Giles, as this mosquito can adapt itself to very varied conditions. The object of this paper is to give an account of the bionomics of *A. gambiae* in the forest zone of the southern part of the Cameroons. It is partly based on work carried out there at irregular intervals between 1948 and 1952, but as the time available was inadequate for many aspects to be studied, these are dealt with by summarising the published results of other workers in other parts of tropical Africa [*R.A.E.*, B **36** 59; **39** 192; **41** 114]. The region and its climate are described. The latter is of the classical subequatorial type with two dry and two wet seasons.

The bionomics of *A. gambiae* in the forest zone were found to be so complex that it was difficult to draw conclusions of general value, but the following points in the life-history are of importance in planning a control campaign. The breeding places are small sunlit, often man-made, pools of clean water, relatively poor in organic matter [*cf.* **41** 115] on laterite or clay. Larvae are present throughout the year and most abundant in the transition periods between the wet and dry seasons. The life-cycle occupies 6–18 days (usually 9–13) according to temperature and the organic content of the water in the breeding place.

Adults rest in dark corners in native huts where they are least likely to be disturbed. They appear to adopt outdoor resting places when houses are sprayed with DDT, but these resting places have not been located in the region. It is possible, alternatively, that an endophilous strain [*cf.* **41** 116] is being destroyed while an exophilous one persists. The effectiveness of systematic spraying against the adults in breaking the cycle of malaria transmission can only be assessed by a large-scale trial. It appears from the literature that the adults enter dwellings between 6 p.m. and 6 a.m. and chiefly between midnight and 5 a.m. The local populations appear to be highly anthropophilous and have a maxillary index of 13·5–14. Effective flight-range does not seem to be much more than half a mile, but 4½ miles can be covered in some circumstances, and the mosquitos can be transported in trains or lorries. The local sporozoite index is high.

Marks (E. N.). **A Review of the *Aedes scutellaris* Subgroup with a Study of Variation in *Aedes pseudoscutellaris* (Theobald) (Diptera: Culicidae).** —*Bull. Brit. Mus.* (*nat. Hist.*) Ent. **3** no. 10 pp. 349–414, 1 pl., 19 figs., 1 map, 3 pp. refs. London, 1954.

The subgroup of *Aëdes scutellaris* (Wlk.) as defined in this paper comprises practically the same complex of species as that termed the *scutellaris* group by Farner & Bohart [*R.A.E.*, B **34** 37] and more recent authors. The following is virtually the author's synopsis. Eighteen described and three undescribed members of the subgroup are recognised from the Australasian region and the eastern part of the Oriental region. The systematic status accorded to them is reviewed, their diagnostic specific characters are critically

examined, and their geographical distribution is illustrated and discussed. An original pictorial chart for identifying them indicates also the geographical distribution of the various taxonomic characters, the implications of which are considered. The general trend is from west to east, but one character shows a north-south distribution. A key to the adults is given for use with the chart, and the inadequate state of present knowledge of immature stages is briefly indicated.

The source of a colony of *A. pseudoscutellaris* (Theo.) and the methods used in rearing it are described, and the results are tabulated of a biometrical study of 28 characters in five series of adults bred from larvae reared in environments that had been subjected to controlled variation of either temperature or salinity and in one series of adults from different stock, also bred in controlled conditions. The records are analysed and their implications discussed. They support the specific status accorded to members of the *scutellaris* subgroup, in that the observed range of experimental variation is not generally so great as interspecific differences in the same character. Lack of variation in the basal lobe of the male coxite is evidence of its value in defining species. Two characters should probably be used with caution in delimiting species, since *A. pseudoscutellaris* can show both extremes of their development. A complete interruption to the white bands on hind tarsal segments II–IV can be produced by low temperatures in the larval environment. The presence or absence of a white streak under the proboscis may be due to differences in hereditary constitution, but larval environment also has some effect.

Rosen (L.) & Rozeboom (L. E.). **Morphologic Variations of Larvae of the *scutellaris* Group of *Aedes* (Diptera, Culicidae) in Polynesia.**—*Amer. J. trop. Med. Hyg.* **3** no. 3 pp. 529–538, 13 figs., 10 refs. Baltimore, Md., 1954.

The species of *Aëdes* of the group of *A. scutellaris* (Wlk.) are differentiated primarily by the structure of the male terminalia, though adult coloration is used in some species. Only in *A. horrescens* Edw., which is known only from Fiji and was originally recognised by the prominent stellate setae of the larvae, has this stage been considered distinctive. These hairy larvae were found primarily in tree-holes [*cf. R.A.E.*, B **33** 104], whereas most species of the *scutellaris* group breed in a variety of small containers. Some members of the group transmit the non-periodic form of *Wuchereria bancrofti* in Polynesia. *A. polynesiensis* Marks [**41** 161] is known to do so, the part played by *A. pseudoscutellaris* (Theo.) is uncertain, *A. tongae* Edw. is suspected of being a vector in Tonga, an endemic area where it is the only member of the group [**34** 38], and *A. horrescens* has been reported to be an unsuitable host [**42** 84].

In the course of studies on *W. bancrofti* in the Society Islands, the senior author found two types of larvae of the *scutellaris* group there, a common type that conformed to the description of *A. polynesiensis* and a less common hairy type, occurring primarily in tree-holes, that conformed in most respects to the description of *A. horrescens*. A colony was established from the latter, but the larvae of the next generation, which were reared on powdered bread-crumbs, resembled those of *A. polynesiensis*. The development of *W. bancrofti* in the parent females, which were fed on an infected donor, was similar both qualitatively and quantitatively to that in females reared from non-hairy larvae. Moreover, young hairy larvae removed from their natural habitat and reared in the laboratory on powdered bread-crumbs became less hairy by the time they reached the fourth instar. Further observations showed that some tree-holes contained larvae intermediate

between the hairy and non-hairy types, a range from one type to the other, or only hairy larvae on one occasion and only non-hairy ones a few weeks later. In general, hairy larvae seemed to occur most often in holes containing a large amount of débris. They were sometimes found in other containers in which the environment resembled that in tree-holes.

The possible association of hairiness with environment was therefore examined. Eggs laid by adults reared from non-hairy larvae were put in pans containing water and débris from a tree-hole that had harboured hairy larvae, filtered water from the tree-hole, or tap water and brewer's yeast. Nearly all hatched. Larvae in the first pan developed into the hairy type and those in the others into the non-hairy type. Mortality was high and growth slow in the first two pans, apparently owing to lack of food. Eggs from the same lot were then put in a pan containing tree-hole water and débris and a little yeast. The larvae that developed were not hairy.

Examination of larvae and associated adults from various islands showed that the male terminalia of adults individually associated with both types of larvae from both the Society Islands and Samoa were identical and conformed to the published descriptions of *A. polynesiensis*. The male terminalia and scutal markings of a few adults bred from and associated with hairy larvae from Fiji were as described for *A. pseudoscutellaris*, but the adults were not individually associated with larval skins. Hairy larvae of another series from Fiji were tentatively identified as *A. pseudoscutellaris* (and not *A. polynesiensis* or *A. horrescens*) on the basis of the ratio between the length of the lower and the upper pairs of anal papillae. Larvae from a London laboratory colony of *A. pseudoscutellaris* and another series of larvae from Fiji tentatively identified as *A. pseudoscutellaris* on the basis of the anal papillae were of the non-hairy type. A single series of larvae from Tonga was non-hairy, and the male terminalia of the associated adults were as described for *A. tongae*. Larvae from the type locality of *A. horrescens*, including some that belonged to the collection from which the type material of the species was bred, were indistinguishable from hairy larvae of *A. polynesiensis*, but the terminalia of a single male from the same collection were distinctly different from those of the other Polynesian species of the *scutellaris* group and were as illustrated for *A. horrescens* [**34** 37]. It is concluded that at least two additional species of the *scutellaris* group (*A. polynesiensis* and *A. pseudoscutellaris*) can have hairy larvae under certain environmental conditions. *A. horrescens* remains a distinct species on the characters of the male terminalia. The environmental factor concerned was not determined. It is evidently associated with débris, but the physical presence of the débris was not in itself responsible. Since Manson-Bahr & Muggleton, in reporting that *A. horrescens* was an unsuitable host for *W. bancrofti* [**42** 84], based their identification on the hairiness of the larvae, it is not known with which species they were working.

Schoof (H. F.) & Siverly (R. E.). **Urban Fly Dispersion Studies with special Reference to Movement Pattern of** *Musca domestica*.—*Amer. J. trop. Med. Hyg.* **3** no. 3 pp. 539–547, 4 figs., 5 refs. Baltimore, Md., 1954.

The following is based on the authors' summary. In continuation of investigations carried out in the summer of 1952 [*R.A.E.*, B **43** 156], about 147,000 radioactive house-flies (*Musca domestica* L.) were liberated at a primary release site at Phoenix, Arizona, on 30th October. For the next two days, 15 fly traps were operated at three secondary sites half a mile from the primary release point. The flies collected at each secondary site were then dusted with a characteristic dye and liberated. Catches at 48

collection stations within a mile of the primary release point indicated that, although fly dispersion from that site followed a general random design [*cf. loc. cit.*], radioactive flies were recaptured at a higher rate in one sector of the recovery zone than in the other two. In all, 104 dyed radioactive house-flies were caught. Movement from each of the secondary release sites was random; some individuals reversed their initial path of migration and returned in the general direction of the primary release site. The findings indicate that *M. domestica* is essentially a species of migrating habits. The flies apparently spend most of their lives moving from site to site not only in search of suitable places in which to feed and breed but also from an inherent instinct to wander.

Burroughs (A. L.) & Burroughs (R. N.). **A Study of the Ecology of Western Equine Encephalomyelitis Virus in the Upper Mississippi River Valley.**—*Amer. J. Hyg.* **60** no. 1 pp. 27–36, 15 refs. Baltimore, Md., 1954.

The ecology of the virus of western equine encephalomyelitis was studied for two years in an area of Minnesota that had had a very high incidence of cases in horses during the preceding ten years. No epizootic was in progress during the study period. Nearly 50,000 mosquitos taken in traps or by hand, several hundred thousand chicken mites (*Dermanyssus gallinae* (Deg.)) from nest and roost débris from fowl shelters, and thousands of other bird mites (*D. americanus* Ewing and *Fonsecaonyssus* (*Bdellonyssus*) *sylviarum* (C. & F.)) from wild birds' nests were used in the attempted isolation of the virus in mice or in hen's eggs. The two methods are described in detail. The virus was isolated from four of 54 pools of *Culex tarsalis* Coq. and one of 469 of *Aëdes vexans* (Mg.), of which nearly 4,000 and over 41,000 individuals were taken, respectively. All mites and other mosquitos were negative. *A. vexans* had not previously been reported infected in nature. The infected pool and two of the infected pools of *C. tarsalis* were from pasture where two equine cases had occurred shortly before. *A. vexans* is often the most abundant mosquito in much of the dry-farming area of the Midwest.

The results of tests for antibodies neutralising the virus in sera of mammals and birds are given in tables that show the numbers of positive, negative and equivocal results with each species tested. Positive results were obtained with horses, pigs, fowls, ducks, seven species of wild birds and one rodent (*Microtus*). Another table contains the results of precipitin tests for horse, cow, pig and avian blood in females of *Anopheles earlei* Vargas, *A. walkeri* Theo., *Aëdes vexans*, *C. tarsalis* and *Mansonia perturbans* (Wlk.). Individuals of each were positive for each kind of blood.

Aitken (T. H. G.), Maier (J.) & Trapido (H.). **The Status of Anophelism and Malaria in Sardinia during 1951 and 1952.**—*Amer. J. Hyg.* **60** no. 1 pp. 37–51, 4 figs., 4 refs. Baltimore, Md., 1954.

Anopheles maculipennis labranchiae Flni. persisted in small numbers in Sardinia after the campaign for its eradication had been brought to an end in October 1950 [*R.A.E.*, B **42** 111], and similar programmes of scouting and establishment of zones for the treatment of larvae were carried out on a smaller scale by the regional government in the next two years. DDT and paris green were used as larvicides in 1951 and fuel oil in 1952. A separate programme, designed to control the adults, was undertaken by an agency of the central government, but it was not completed in either year. There was no rapid increase in the numbers of the mosquito from the small residual

population that remained at the end of 1950 [*cf.* **43** 44]. In 1951, with a maximum scouting force of 380 men (compared with 2,000–3,000 during the main campaign), it was found in 86 of the 5,229 administrative sectors of the island. The positive sectors were nearly all coastal and mainly in the north-east. Between 7th May and 20th October, 1,110 larvae and pupae of *A. m. labranchiae* were collected, as well as 17 adults of the complex of *A. maculipennis* Mg. (also probably *labranchiae*). The work in 1952 is described in some detail. In that year, a maximum scouting force of 730 men found larvae of *A. m. labranchiae* in 64 sectors and larvae of *A. m. sacharovi* Favr (which was taken for the first time since 1940) in 11 others. Positive localities were still coastal, but were more evenly distributed between the north and south. *A. m. sacharovi* was restricted to the north. The tendency for *A. m. labranchiae* to be found most often at some distance from towns and villages, observed since 1949, persisted. Between 7th April and 31st October, 597 larvae and pupae and one adult of *A. m. labranchiae* and 160 larvae of *A. m. sacharovi* were collected. Together they made up less than 0·1 per cent. of the Anopheline larvae found in 1952, of which 57 and 40 per cent. were *A. claviger* (Mg.) and *A. algeriensis* Theo. and the others were *A. marteri* Sen. & Prun., *A. hispaniola* (Theo.) and *A. plumbeus* Steph. The regional scouts also collected adults of *claviger* and *algeriensis* in 1952, but could find none of *sacharovi* or *labranchiae*, and only one *labranchiae* adult was taken in a special investigation in the Geremeas valley [**43** 44].

Nine cases of malaria were officially reported in 1951, of which one in a child 18 months old appeared to be a true primary infection. No cases were reported in 1952. Examination of more than 4,000 schoolchildren in 27 villages showed spleen and parasite rates of 13·79 and 0·16 per cent., respectively, in 1951 and 18·43 and 0·09 per cent. in 1952. Blood examinations of 815 and 1,001 infants were negative.

Roubaud (E.) & Toumanoff (C.). **Déplacements des anophèles consécutifs aux traitements larvicides.**—*Bull. Soc. Path. exot.* **47** no. 1 pp. 91–97, 9 refs. Paris, 1954.

Populations of *Anopheles maculipennis* Mg. in the plains and valleys of Corsica have been greatly reduced by extensive control operations that have been carried out since 1948 and in which DDT and Octaklor [chlordane] have been used against the adults and oil containing 5 per cent. DDT against the larvae. However, the reduction has been accompanied by a movement of the mosquitos towards the mountains, outbreaks of malaria have occurred at altitudes previously considered healthy, and *A. maculipennis*, alone or with other Anophelines, is now dominant at places in which *A. claviger* (Mg.) (*bifurcatus*, auct.) was generally found alone in 1947. In 1950, it was widely distributed at altitudes of up to about 2,000 ft., sometimes in sufficient numbers for control measures to be needed. During 1953, larvae of *A. maculipennis* were found at 1,100 ft. and in two places at 1,600 ft., and an adult female taken at one of the latter was identified as *A. m. labranchiae* Flni. The movement from the plains is attributed to the reaction of ovipositing females repelled from breeding places fouled by larvicidal oiling and forced into areas where they oviposit in inaccessible places difficult to locate. The effect is the same whether the oil serves as a carrier for a synthetic insecticide or not. To obviate it, the first author advocated the use of insoluble powders as larvicides [*R.A.E.*, B **14** 121]. It is suggested that the same reaction accounts for the survival of a residual population of *A. m. labranchiae* after the eradication campaign in Sardinia [*cf.* preceding abstract].

Gaud (J.), Laurent (J.) & Faure (P.). **Biologie de** *Musca sorbens* **et rôle vecteur probable de cette espèce en pathologie humaine au Maroc.**—*Bull. Soc. Path. exot.* **47** no. 1 pp. 97–101, 1 ref. Paris, 1954.

Two domestic species of *Musca* occur in Morocco. These are *M. sorbens* Wied. and *M. domestica* L. (represented by forms *vicina* Macq. and *cuthbertsoni* Patt.). Both can develop in a wide variety of media, but *M. domestica* usually oviposits on the dung of animals, mainly cattle and equines, and the larvae develop chiefly in large or sheltered manure heaps as they require protection from desiccation, whereas *M. sorbens* breeds in human excrement in the open, or sometimes in pig dung. Sugary substances are the chief food of adults of *M. domestica*, but *M. sorbens* is most attracted to meat, wounds and pathological secretions, and settles persistently on the human body, particularly near the eyes, nose and mouth. It seldom rests in houses, which it enters only on the person, but normally on vegetation. It is thought to have a shorter larval stage than *M. domestica*, with a longer interruption of reproduction in winter and a more marked one in summer. Its habits make it a more likely vector of ocular and intestinal infections and of poliomyelitis than *M. domestica* and prevent it from being controlled by insecticide deposits on walls. The beneficial effect on acute conjunctivitis that has followed fly control in certain parts of southern Morocco is attributed to the extension of insecticide application to yards and covered alleys.

Hamon (J.). **Contribution à l'étude des culicidés de la région de Bamako (Soudan français).**—*Bull. Soc. Path. exot.* **47** no. 1 pp. 178–185. 15 refs. Paris, 1954.

In a survey, mainly of breeding places, made in October 1953 in the Bamako region, 23 species of mosquitos, including 14 species of *Anopheles* were recorded. Eight species of *Anopheles* (*brunnipes* (Theo.), *domicolus* Edw., *flavicosta* Edw., *leesoni* Evans, *rivulorum* Leeson, *wellcomei* Theo., *rhodesiensis* Theo. and *pretoriensis* (Theo.)) and all the other mosquitos were additions to the fauna of the locality. All 17 were also new to the French Sudan [*cf. R.A.E.*, B **28** 13; **35** 45], except *A. domicolus*, which with *A. paludis* Theo. was recorded from there by M. Holstein in 1950 without more precise indication of locality. *A. wellcomei* and six species of other genera are thought to be new to French West Africa. Data are given on the distribution of the species among the different types of breeding place, on morphological variation in the larvae and on the relative prevalence of the Anophelines. This is quite unlike any recorded previously for the region, as *A. gambiae* formed only 7·7 per cent. of the total, and raises doubts as to the identity of the local vector of malaria.

Jayewickreme (S. H.). **Observations on the Bionomics of some Anopheline Mosquitoes reared in the Laboratory. Part I.** *Anopheles subpictus* **Grassi and** *Anopheles vagus* **Dönitz.**—*Ceylon J. Sci.* (B) **25** pt. 2 pp. 75–95, 11 refs. Colombo, 1953. **Part II. Effects of larval Population Density on the Life Cycle of** *Anopheles subpictus* **Grassi.**—*T. c.* pp. 97–105, 11 refs. **Part III.** *Anopheles culicifacies* **Giles.**—*T. c.* pp. 107–116, 9 refs.

The rearing of *Anopheles subpictus* Grassi and *A. vagus* Dön. at 77–84·2° F. (laboratory temperature at Colombo) in various media is recorded in the first paper. The life-cycles under these conditions are discussed in detail. In the 32 experiments made with *A. subpictus*, in which 1,843 larvae pupated and 1,664 adults emerged and there was adequate food and no

overcrowding, pupation and adult emergence were almost completed by the 14th and 15th days, respectively. The day on which the female was given access to water is counted as day 1. In 14 similar experiments with *A. vagus*, in which 854 larvae pupated and 780 adults emerged, pupation and emergence were almost completed on the 12th and 13th days. The minimum times taken for all larvae to pupate were 11 days for both species when the medium was boiled mud-water. There was a definite tendency for females to outnumber males in *A. subpictus* and for males to outnumber females in *A. vagus*. This was also true for most individual days of emergence. The bulk of emergence in both species took place within a period of three days.

The second paper contains details of experiments in which larvae of *A. subpictus* were successfully reared in various media at 11 densities such that the area per larva ranged from 3·14 to 20·45 sq. cm. The results indicate that overcrowding did not reduce the percentages of larvae that pupated and gave rise to adults, and it did not extend duration of the life-cycle much beyond the average (15 days).

In the third paper, results are given of experiments in rearing *A. culicifacies* Giles at Colombo in tap water containing various concentrations of dried powdered mud. Toasted brown bread, finely ground and sieved, was supplied as food. Pupation was virtually completed by the 16th day after oviposition, and adult emergence by the 17th day. Maximum pupation occurred on the 13th or 14th day and maximum adult emergence on the 14th or 15th day. There was some day-to-day variation in the proportions of the sexes emerging, but the ratio at the end of each experiment was about 1:1. Most adults emerged on the second day on which emergence occurred and 83·5 per cent. had emerged by the fourth day. Only 9·1 per cent. emerged on the first day. Growth of larvae and pupation were not adversely affected by crowding, even at the highest density tested (5·4 sq. cm. per larva). The depth of the liquid was 1 inch. Increasing the proportion of dried mud accelerated development and increased the numbers reaching maturity.

Atchley (F. O.), Traylor (W. R.) & Weathersbee (A. A.). **Effects of Variations in Reservoir Levels, Rainfall, and Temperature on Anopheline Densities in a Coastal Plains Area in South Carolina.**—*J. Parasit.* **41** no. 3 pp. 273–280, 5 graphs, 3 refs. Lancaster, Pa., 1955.

The effects of rainfall, temperature and the water level of the reservoir on densities of *Anopheles quadrimaculatus* Say and *A. crucians* Wied. were studied in the neighbourhood of the Santee Reservoir, east-central South Carolina in 1947–51. The terrain is very flat, and the extensive marginal plant growth that developed round the reservoir during recessions provided favourable breeding places for *A. quadrimaculatus*. Indices of mosquito populations were obtained by weekly diurnal counts of adults in occupied mule stables. Populations of *A. quadrimaculatus* were generally affected by the conditions of the reservoir, its principal local breeding place. When the water level remained near the five-year average, or slightly below it, with little summer fluctuation, the population was relatively small. Densities were much greater when the level was high, as they were in 1948 and 1949. Low spring population in 1949 was probably due to prolonged cool weather. Densities of *A. crucians* were influenced principally by the levels of the woodland ponds in which it mostly bred. These varied with rainfall and also with fluctuations in the adjacent reservoir. High temperatures had no apparent effect on the density of either species, presumably because atmospheric humidity was maintained by evaporation from the reservoir, but

temperatures below 40°F. reduced density. The greater prevalence of *A. crucians* observed in early spring and late autumn suggests that it can develop at lower temperatures than can *A. quadrimaculatus*.

Barr (A. R.). **A Case of "Mange" of the Domestic Rabbit due to *Cheyletiella parasitivorax* (Megnin).**—*J. Parasit.* **41** no. 3 p. 323. Lancaster, Pa., 1955.

A domestic rabbit, which was seen in November 1952 to have an area of loose and roughened fur measuring 3 by 8 inches in the scapular region, was found to be heavily infested with *Cheyletiella parasitivorax* (Mégn.). The area was shaved, and a dense layer of material about 2 mm. thick, comprised of hair, detritus, mites of all stages and exuviae, was found just above the skin. The skin was inflamed over almost the whole area, and there were droplets of exuded serum on a patch of intense inflammation. Careful searching failed to reveal the presence of any other ectoparasites in the infested material, and no other areas of infestation could be seen on the rabbit. The shaved area was treated with benzyl benzoate, and no subsequent cases were seen in the rabbit colony. The pathogenicity of *C. parasitivorax* has often been questioned [*cf. R.A.E.*, B **38** 190], but, as the mite has been taken from a number of hosts on many different occasions, often in large numbers, and sometimes in the apparent absence of other ectoparasites [*loc. cit.*], and was associated with definite lesions in this case and that reported by Vail & Augustson [**32** 138], the author believes that its pathogenicity can no longer be doubted [*cf.* also **39** 38].

Lipovsky (L. J.). **Collembola as Food for Chiggers (Acarina-Trombiculidae).**—*J. Parasit.* **37** no. 3 pp. 324–326. Lancaster, Pa., 1951.

During investigations on the rearing of Trombiculids at the University of Kansas, it was found that the nymphs and adults would feed on the eggs of insects of several orders, and food for the cultures was supplied in the form of gravid ovaries dissected from insects collected in the field. This, however, involved the constant addition of fresh material, which was not always available, and favoured mould growth in the cultures, so that it was difficult to keep them healthy. Various Collembola were being cultured at the same time, the only food required for them being active dried yeast pellets, and it was found that some of them, particularly Entomobryids, could be maintained in mixed cultures with the Trombiculids and would then keep them in good condition by reducing the growth of moulds and clearing up undesirable débris. Moreover, one of the Entomobryids used was *Sinella curviseta* Brook, and this species, which was more prolific than the others, laid eggs that were suitable food for the mites of some genera, while those of other genera fed on the active insects or on both insects and eggs. It provided all the food needed by the mites in a mixed culture and sometimes became so abundant that its numbers had to be reduced. If this occurred some of the insects were crushed and these served as extra food for the others and in some cases for the mites. Depriving the Collembola of the yeast pellets was not a satisfactory way of limiting the colony as they then tended to prey on the mites and the supply of eggs became insufficient for the latter, which consequently ate their own eggs. Genera that were successfully reared in conjunction with *Sinella* included *Acomatacarus*, *Euschöngastia*, *Hannemania*, *Neoschöngastia*, *Trombicula* and *Walchia*. About 25 species were reared to the adult stage and eggs and larvae subsequently obtained from about 15 of them.

Lipovsky (L. J.). **Improved Technique for rearing Chigger Mites (Acarina: Trombiculidae).**—*Ent. News* **64** no. 1 pp. 4–7. Lancaster, Pa., 1953.

Descriptions are given of a culture tube and dish, both lined with a mixture of plaster of paris and charcoal (12:1 by volume), that have been used successfully for rearing Trombiculids for four years. The tube, which is intended chiefly for keeping engorged larvae until they have moulted, is a modification of one described by Farrell & Wharton for conveying Trombiculid larvae [*R.A.E.*, B **39** 89]. It has a plastic stopper and, prepared as directed and with the stopper in place, will maintain a uniform humidity for many months. A few longitudinal slits are made in the lining to admit light. If a tube is opened frequently, a few drops of water may be added.

The dish allows of convenient observation and manipulation of nymphs and adults. It is a stender dish with an inside diameter of 65 mm. and is 20 mm. deep. It is given a thin smooth lining except for a band 6 mm. deep at the top, which acts as a barrier. The outside of the dish and the entire lid should be coated with paraffin wax and the lid covered on the inside with waxed paper, which is attached by placing the sheet of paper over the dish, pressing the lid on it, folding the paper over the top of the lid and fusing it to the wax. A space should be left between the inner central portion of the paper and the lid. Instead of a substratum over the lining [*cf.* **39** 146], two grooves on the bottom 2 mm. deep and 2 mm. wide in the form of a cross provided an adequate niche for nymphs and adults where they remained visible under a microscope. Food should be provided to minimise the risk of eggs being eaten. In dishes that contain both Trombiculids and Collembola [see preceding abstract] for several weeks, the grooves become filled with eggs, exuviae and other débris under which the Trombiculids hide, and they should be cleaned periodically to avoid injury to the mites during attempts to locate them.

Basu (B. C.), Balarama Menon (P.) & Sen Gupta (C. M.). **Regional Distribution of *Tabanus* Flies in India and its Relationship to the Incidence of Surra.**—*Indian J. vet. Sci.* **22** (1952) pt. 4 pp. 273–292, 2 pls., 3 refs. Delhi, 1953.

A list is given of the 75 species of *Tabanus* that are known to occur in India, Pakistan, Ceylon, Burma, the Perso-Baluchi-Afghanistan area or the the Nicobar Islands, and the areas from which each has been recorded are shown. The distribution of those present in the Indian subcontinent is also plotted on a map, which is divided into five regions (temperate Himalayan, eastern wet, north-western dry, southern and south coastal wet), and the distribution of the 54 species found in the Indian Union is further analysed according to the natural physical divisions of the country. The montane, submontane, pastoral and coastal regions have, respectively, 30, 32, 23 and 15 species, of which 10, 3, 7 and 3 occur only in the region concerned. *Tabanus rubidus* Wied. is found in all the regions of both classifications and in Ceylon and Burma. Ceylon, Burma and the area comprising Persia, Baluchistan and Afghanistan have 14, 19 and 6 species, of which 9, 4 and 4, respectively, do not occur elsewhere in the area discussed. *T. nicobarensis* Schiner is the only species recorded from the Nicobar Islands and is confined to them.

Seven of the species dealt with, all of which occur in India, have been recorded as able to transmit surra [*Trypanosoma evansi*], but the authors consider that *Tabanus rubidus* is undoubtedly the principal vector and that the evidence of transmission by the other six, which include *T. striatus* F. [*cf. R.A.E.*, B **15** 191; **16** 109; **17** 92], is meagre. The numbers of cases

of surra reported in equines, camels and bovines in the various provinces and states of the Indian Empire between January 1940 and December 1942 are shown in a table. They were 4,537, 4,343 and 491, respectively, in the Punjab and 1,532, 570 and 513 elsewhere.

Gurney (A. B.). **Distribution, general Bionomics, and Recognition Characters of two Cockroaches recently established in the United States.**—*Proc. U.S. nat. Mus.* **103** no. 3315 pp. 39–56, 1 pl., 1 fig., 52 refs. Washington, D. C., 1953.

Two cockroaches of potential importance have recently become established in the north-eastern United States. They are *Ectobius lividus* (Turton) and *Leucophaea maderae* (F.). *E. lividus* has been collected in three places in Massachusetts since 1948, occurring in houses and on fresh vegetables as well as out of doors. *L. maderae*, a tropical species that has often been intercepted at ports, was found in the autumn of 1950 established in the basements of buildings in New York occupied by people from Porto Rico. Descriptions are given of both species, with notes on their nomenclature and world distribution. *E. lividus* was probably introduced from western Europe or the Mediterranean area. It was found in various situations, but most consistently on trees. It is thought unlikely that it will develop into a major pest in buildings, but it may periodically become a nuisance in houses or gardens. In the absence of studies on *L. maderae* in the United States, observations on its bionomics elsewhere are reviewed. It forms large, localised colonies in Porto Rico, especially in fruit stores and markets. It might, if allowed to spread, develop into a serious pest in large cities. A related species, *Nauphocta cinerea* (Ol.), has recently become established in Florida, where it has been found in considerable numbers in commercial buildings where animal feeding stuffs are manufactured. It might increase enormously in such buildings [*cf. R.A.E.*, B **31** 106].

Wright (C.) & Wright (D.). **Our Experience with Malrin for German Roach Control.**—*Pest Control* **23** no. 8 pp. 34, 36, 1 graph. Painesville, Ohio, 1955.

In 1954, a very heavy infestation of *Blattella germanica* (L.) in 12 blocks of 12 flats at Dallas, Texas, failed to respond to routine control measures. Tests against a collection of these cockroaches (designated the Dallas C-9 strain) showed that they were even more resistant to chlordane than the resistant colony from Corpus Christi [*R.A.E.*, B **41** 179], but that Malrin, a new experimental material defined as being composed of 66⅔ per cent. technical 1,1-dichloro-2,2-bis (p-ethylphenyl) ethane [ethyl-DDD] and 33⅓ per cent. technical O,O-dimethyldithiophosphate of diethylmercaptosuccinate [malathion], was highly effective against them. At 100 mg. per sq. ft. Malrin gave complete kill in five hours, whereas chlordane failed to do so in 125 hours. The 144 flats were treated with Malrin monthly for six months from 30th September 1954. Two preparations containing 55 per cent. Malrin were applied as sprays in water; one, termed emulsion concentrate, was at concentrations of 8, 16 and 24 fl. oz. per U.S. gal., and the other, termed oil soluble, was at 8 fl. oz. per U.S. gal. only. The initial application was at 2 U.S. pints spray per flat and subsequent ones at 1 U.S. pint. The data obtained are summarised in a comprehensive table. They show that when the emulsion concentrate was used, cockroaches were eliminated from 70 per cent. of the premises by one treatment, from 95 per cent. by two and from all by three. The third application was needed only with the lowest concentration. Four or five applications were needed in seven of the

36 premises where oil-base preparation was used, probably because of absorption of the oil by the treated surface.

Abramov (I. V.). **The Duration of the Preservation of the causal Agent of Piroplasmosis of Horses** (*Piroplasma caballi*) **in the Ticks** *Hyalomma plumbeum* **Panzer, 1795.** [*In Russian.*]—*Veterinariya* **32** no. 3 pp. 42–46, 8 figs., 3 refs. Moscow, 1955.

Hyalomma marginatum Koch (*plumbeum*, auct.) is widely distributed in the south of the Soviet Union, where it is one of the major vectors of *Piroplasma caballi*. Experiments by the author have shown that this piroplasm can persist in ticks of the genus *Dermacentor* when they are reared for three or four generations on non-susceptible animals [*cf.* also *R.A.E.*, B **34** 112; **42** 178], but nothing was known of its persistence in *H. marginatum* beyond the fact of its transmission through the eggs of infected females to the succeeding generation. In view of this, seven successive generations were reared on rabbits from a single female that had engorged on an infected foal, and were tested for infectivity by examining smears of the eggs and organs of the ticks and by allowing adults to feed on healthy foals. Infection was demonstrated in all generations by the first method, *P. caballi* in different forms occurring in the eggs and in the organs of both males and females. The forms observed are illustrated. The intensity of infection was sometimes very high, particularly in the eggs, and heavily infected eggs frequently failed to hatch. The feeding tests were carried out with all generations except the fifth, and all resulted in infection of the test foals. The initial female from which the seven generations were reared dropped from its host in January 1952 and the test with the seventh generation was in November 1954.

Ul'yanov (P. V.), Chistyakov (F. A.), Zhinkin (P. V.) & Chayanov (Yu. A.). **The Course of Babesiellosis of Cattle in Localities in which the Ticks** *Ixodes persulcatus* **occur.** [*In Russian.*]—*Veterinariya* **32** no. 4 pp. 45–47. Moscow, 1955.

The Province of Ivanovsk, in central Russia, was long considered to be free from cattle piroplasmosis caused by *Piroplasma* (*Babesiella*) *bovis*, but sporadic outbreaks of the disease, usually in different districts, have occurred in recent years. *Ixodes ricinus* (L.), the main vector, has not been observed in the districts affected, but *I. persulcatus* Schulze, which has been shown to transmit it experimentally [*cf. R.A.E.*, B **30** 142] and under field conditions, was found to be widely distributed in them and in those adjacent to them. Outbreaks associated with *I. persulcatus* differed from those due to *I. ricinus* in that they were very local and occurred in previously uninfected districts and only when the spring was early and the months of May and June were warm. They were usually severe, mortality reaching 36–88 per cent.

Details are given of a mild outbreak that affected 17 of a herd of some 50 cows in 1954 on a farm previously free from the disease. It lasted from 5th June until the end of July, blood infection was light, and only two of the animals died. Examinations of the whole herd during the outbreak resulted in the finding of a few examples of *I. persulcatus*. Infestation by ticks was stated to occur commonly at the end of May and the beginning of June and to disappear suddenly. Ticks had been more numerous in 1954 than in previous years. The way in which the infection was introduced is unknown, but the suddenness of the outbreak indicated that it was due to infestation by *I. persulcatus*, which was favoured by the weather.

Chereshnev (N. A.). **Skin Myiases in Man caused by Larvae of the first Instar of Stomach Botflies (Fam. Gastrophilidae).** [*In Russian.*]—*Dokl. Akad. Nauk SSSR* (N.S.) **99** no. 4 pp. 661–664, 2 refs. Moscow, 1954.

Cases of myiasis in man due to *Gasterophilus* have been recorded, but little is known as to the species concerned or the way in which infestation begins. In the course of investigations on infestation in horses [*R.A.E.*, B **43** 52], the author studied the behaviour of the larvae of six species on the back of his hand or on the fore-arm. First-instar larvae of *G. pecorum* (F.), *G. nigricornis* (Lw.), and *G. inermis* (Brauer) placed on the skin and those of *G. haemorrhoidalis* (L.) that hatched from eggs laid on the hairs penetrated the unbroken epidermis and burrowed in the skin, those of the first two species entering within 3–5 minutes. Three of the five larvae of *G. pecorum* were encapsulated and dead 4–5 days later, a fourth was lost on the ninth day through scratching at night, and the fifth was removed alive after ten days. One larva of *G. nigricornis* remained in the skin for 12 days and another for 15, but both were then lost through scratching. Of the two larvae of *G. haemorrhoidalis*, one was soon lost, but the other burrowed for nine days, after which it was removed alive. The larvae of these three species increased in size while in the skin; their burrows and the irritation and pain they caused are described. Larvae of *G. inermis* entered the skin in 10–15 minutes, but were removed three days later owing to the unbearable itching caused. When larvae of *G. intestinalis* (Deg.) and *G. nasalis* (L.) (*veterinus* (Clark)) were placed on the hand, they crawled over the moistened skin for two hours but were unable to penetrate it [*cf.* **43** 53].

The author suggests that infestation of man may occur either through contact of moist hands or other uncovered parts of the body with fully developed eggs of *Gasterophilus* on the hairs of horses or, in the case of *G. pecorum*, on plants [*cf.* **41** 183], which would induce hatching, or through accidental oviposition by the flies on the hairs of the skin. He has observed several instances of oviposition on man by females of *G. nigricornis*, *G. haemorrhoidalis* and *G. flavipes* (Ol.) that were flying around horses, and such oviposition by the last two species was repeatedly induced by covering the lips of a horse with the palm of the hand, the flies alighting on the back of the hand and depositing eggs on the hairs close to the skin. By passing his moist hand over grass on which *G. pecorum* had oviposited, the author caused some of the eggs to hatch, and the larvae adhered to the hand and penetrated the skin.

Papers noticed by Title only.

Hawes (I. L.). **Index IX to the Literature of American Economic Entomology January 1, 1948 to December 31, 1949.**—*Spec. Publ. ent. Soc. Amer.* no. 9 [8+] 528 pp. Washington, D.C., 1954. **Index X . . . 1950.**—*Spec. Publ. Amer. Ass. econ. Ent.* no. 10 [7+] 322 pp. College Park, Md., 1952. **Index XI . . . 1951.**—*Op. cit.* no. 11 [8+] 325 pp. 1953. [*Cf. R.A.E.*, B **40** 168.]

Rageau (J.). **Clés pour l'identification des tiques du Cameroun.**—*Ann. Parasit. hum. comp.* **28** no. 5–6 pp. 399–411, 17 refs. Paris, 1953.

Pengelly (R.). **Pesticide Quarterly Supplement no. 9, April 1955.**—pp. 432–454, 12 refs., multigraph. [Canberra] Dep. Hlth. Aust., 1955. [*Cf. R.A.E.*, B **41** 77, 213.]

Kozłowski (S.). **Pierwsze doniesienie o stosunkach ilościowych panujących wśród populacji kleszczy** *Ixodes ricinus* **(L.).** [First Communication on quantitative Relations existing within a Population of the Tick *I. ricinus*.]—*Ekol. polska* **1** pt. 3 pp. 5–16, 2 figs., 11 refs. Warsaw, 1953. (With Summaries in Russian and English.)

During the summer of 1952, larvae, nymphs and adults of *Ixodes ricinus* (L.) were collected in a marshy part of a forest in Poland by sweeping the ground and plants with a flannel drag. They were irregularly distributed over the area surveyed (about 120 acres); there were dense populations of larvae restricted to small areas in which females had oviposited, less dense aggregations of nymphs and adults over areas of several hundred square feet, and still larger areas over which the ticks were more numerous than they were elsewhere.

In discussing the possibility of defining the characteristics of infested areas, the author concludes that the entire biocoenosis must be considered since the area as a whole must be favourable to the small mammals that are the hosts of the ticks, though the latter are numerous off their hosts in places in which the microclimate is suitable for oviposition, hatching and the moulting of nymphs. Such places are characterised by dampness of the soil and air and only small fluctuations in temperature. Though plants and microclimate affect each other, it was not possible to establish a relation between the abundance of ticks and any specific vegetation cover.

Zhmaeva (Z. M.), Pchelkina (A. A.), Mishchenko (N. K.) & Karulin (B. E.). **The Epidemiological Importance of Ectoparasites of Birds in a natural Focus of Q Fever in the South of Central Asia.** [*In Russian.*]—*Dokl. Akad. Nauk SSSR* **101** no. 2 pp. 387–389. Moscow, 1955.

Investigations on possible vectors and reservoirs of a disease, subsequently identified as Q fever, that occurred among people in the south of Soviet Central Asia in 1953 [*cf. R.A.E.*, B **43** 147] led to the discovery that *Coxiella* (*Rickettsia*) *burneti* was present in various parts of the southern desert in the rodents, *Rhombomys opimus* and *Spermophilopsis leptodactylus*, and the field sparrow, *Passer montanus pallidus*, and also in *Hyalomma excavatum* Koch, *H. detritum* Schulze, *Argas reflexus* (F.), Laelaptid (Dermanyssid) mites and *Leeuwenhoekia major* Shluger. Moreover *H. asiaticum* Schulze & Schlottke, *H. marginatum* Koch (*plumbeum*, auct.) and *Rhipicephalus turanicus* Pom. readily transmitted it from infected to healthy guineapigs and preserved it through all stages of their development, including the egg, and *H. marginatum* also transmitted it to chickens, which sickened and died.

Investigations on the field sparrow and its parasites were carried out in a village in the valley of the Kashka-Dar'ya (south-western Uzbekistan), where it was very numerous, nesting under the roofs of the houses and in cracks in the walls, and also in holes in the loess ravines near the village. The ectoparasites found in greatest numbers in the nests were *A. reflexus* and the mites, *Dermanyssus passerinus* Berl. & Trt. and *Steatonyssus viator* (Hirst). Injections of suspensions into the abdomens of guineapigs resulted in the isolation of one strain of *C. burneti* from the brains of sparrow nestlings and others from a pool of examples of the two species of mites taken from nests in ravines and from examples of *A. reflexus*, including one lot of nymphs that had engorged in the nests but had then been kept for seven months in the laboratory, where they dried up. All these strains

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behaved similarly in guineapigs or white rats, and produced similar pathological changes in guineapigs. Guineapigs that had recovered from infection with the strain obtained from the mites were immune from infection with strains isolated from Q fever patients, and *vice versa*.

It is considered probable that *D. passerinus*, *S. viator* and *A. reflexus*, which are widely distributed in the region, are all of importance in the maintenance of the rickettsiae and the infection of birds, and that the two mites, both of which are known to attack man, may also be concerned in human infection.

ZEMSKAYA (A. A.) & PCHELKINA (A. A.). **Experimental Infection of the Bird Mite** *Dermanyssus gallinae* **Redi and the Rat Mite** *Bdellonyssus bacoti* **Hirst with the causal Agent of Q Fever.** [*In Russian.*]—*Dokl. Akad. Nauk SSSR* **101** no. 2 pp. 391–392. Moscow, 1955.

In view of the isolation of *Coxiella* (*Rickettsia*) *burneti* from sparrow mites [see preceding abstract], experiments on its transmission by *Dermanyssus gallinae* (Deg.) and *Bdellonyssus bacoti* (Hirst) were carried out. Both species acquired the infection from guineapigs on which they fed during the period of fever and infected healthy guineapigs on which they fed 10–15 days later. *D. gallinae* also infected chickens and was able to infect two birds in succession, or a bird and a guineapig. Transmission was obtained in one instance from the bite of a single female of *B. bacoti*, and infected females of this species and *D. gallinae* were still able to transmit after having been fed ten and seven times, respectively, on healthy animals. It was also shown that infected females that fed on healthy animals preserved the rickettsiae for up to six months, and a suspension prepared from 19 dead examples of *B. bacoti* that had been kept for 75 days in a closed test-tube proved infective to a guineapig.

WARD (J.). **Separation of the " Pyrethrins " by displacement Chromatography.**—*Chem. & Ind.* 1953 pp. 586–587, 1 graph, 8 refs. London, 1953.

Chromatographic methods have been employed for the separation of pyrethrin I and cinerin I from pyrethrin II and cinerin II [*cf. R.A.E.*, B **41** 168], and an account is here given of investigations in which displacement chromatography was used to separate these four main constituents of pyrethrum extract from one another and from certain impurities present in the extract after purification by the nitromethane method [**33** 98].

The biological activity of each of these four fractions from the column was determined by topical application of a drop (1 μl.) of solution in acetone to *Phaedon cochleariae* (F.). The median lethal concentrations, determined graphically and expressed as per cent. w/v, were 0·001 for pyrethrin I, 0·002 for cinerin I, 0·0026 for pyrethrin II and 0·005 for cinerin II, as compared with 0·025 for allethrin.

MCGREGOR (W. S.), RADELEFF (R. D.), CLABORN (H. V.) & BUSHLAND (R. C.). **Dieldrin, Aldrin & Lindane—Systemic Insecticides against Livestock Pests.**—*Agric. Chem.* **10** no. 1 pp. 34–36, 123, 3 refs. Baltimore, Md., 1955.

The following is mainly based on the authors' summary of this paper in which experiments made in Texas in 1952 and 1953 are described. Of 12

chlorinated-hydrocarbon insecticides tested for systemic activity by subcutaneous injection of solutions into guineapigs infested with *Callitroga hominivorax* (Coq.), five were found effective, and γ BHC (lindane), dieldrin and aldrin were chosen for further study. Infested cattle were treated subcutaneously with 5 per cent. solutions of these materials in groundnut oil. Dieldrin at 25 mg. per kg. and aldrin and γ BHC at 50 mg. per kg. killed larvae infesting the host at the time of treatment and those introduced into wounds made up to a month after it.

The same treatments given at intervals of 28 days to cattle naturally infested with *Hypoderma lineatum* (Vill.) had no effect on first-instar larvae but so affected second- or third-instar larvae that they died in the cysts or in the pupal stage. The cattle in these experiments were treated up to six times with dieldrin or BHC, but one of those treated with aldrin died of poisoning after the third injection, and the others were not treated with it further. When similar treatments were given to cattle naturally infested with second- and third-instar larvae of *H. bovis* (Deg.), most of the larvae were killed, but a few survived to produce apparently normal flies.

Since all three insecticides were lethal to cattle when given orally at 25 mg. per kg., subcutaneous injections are required for safe treatment of a cow with a quantity large enough for the desired systemic effect. Subcutaneous injections of groundnut-oil solutions of the insecticides caused the chemicals to be deposited in the fat of the cattle. Large deposits of aldrin and dieldrin still remained four months after treatment, but BHC had almost disappeared from the fat by this time.

Bradbury (F. R.) & Standen (H.). **The Fate of γ-Benzene Hexachloride in normal and resistant Houseflies. I.**—*J. Sci. Fd Agric.* **6** no. 2 pp. 90–99, 15 refs. London, 1955.

House-flies (*Musca domestica* L.) of a normal strain and a strain resistant to BHC were exposed to γ BHC labelled with ^{14}C, and the fate of the insecticide in them was studied by radio-chemical methods, which are described. Some of the flies were exposed in stoppered flasks lined with the insecticide deposited from a carbon-tetrachloride solution. Others were exposed on impregnated filter paper in the inverted lid of a petri dish into which the base was pressed down to keep them in close contact with the paper. After the exposure of the flies, the fractions of γ BHC in the outside and inside tissues were separately removed, by extraction with carbon tetrachloride before and after the flies were ground. As it had been shown that flies reared from larvae fed on a medium containing γ BHC themselves contained appreciable quantities, larvae of the generation to be used for experiments were normally fed on medium free of the compound.

The outside and (in brackets) inside tissues of females of the normal strain exposed for 0·5, 1, 2 and 4 hours on filter paper, contained the equivalents of 0·17 (0·15), 0·19 (0·26), 0·2 (0·51) and 0·3 (0·59) μg. BHC per fly, respectively, and the corresponding figures for the resistant strain were 0·12 (0·07), 0·14 (0·13), 0·17 (0·29) and 0·2 (0·37). The tendency for the amount of BHC to reach a steady value rapidly in the outside tissues and to rise gradually in the inside tissues was even more marked in the results of colorimetric analysis where exposure was in flasks and continued for 17 hours. The differences in the values for the two strains indicate that the resistant flies are more resistant to penetration by γ BHC or can convert it to a degradation product that does not appear in the extraction process. It had been expected that they might convert it to dehydrohalogenation products, of which the most likely would be trichlorobenzene or pentachlorocyclohexene, but attempts to isolate trichlorobenzene from the extracts of

their inside tissues were unsuccessful, and the results of paper chromatography indicated that the radioactive compound in these extracts was γ BHC.

Carbon-tetrachloride extraction, however, did not result in the recovery of all the radioactive matter taken up by flies from a treated flask in six hours. There was an unextracted residue in both resistant and non-resistant flies, but it was about twice as great in the former. Part of it was extracted from both strains with hot water, but some still remained in the tissues. The water-soluble product has not yet been identified. It is evident therefore that both normal and resistant flies convert some of the absorbed γ BHC into a compound or compounds insoluble in carbon tetrachloride and that resistant flies convert more of the insecticide than do normal ones. As normal flies showed more radioactivity than resistant ones in "outside" as well as "inside" carbon-tetrachloride extracts, γ BHC may have been lost by conversion into a compound insoluble in carbon tetrachloride outside the flies as well as inside them [*cf. R.A.E.*, B **39** 211]. The conversion of larger amounts by the resistant flies may, however, be the result of their longer survival and have no connection with the cause of their resistance [*cf.* **41** 123].

Morrison (F. O.) & LeRoux (E. J.). **House Fly Head as Site of lethal Action of DDT.**—*Canad. J. agric. Sci.* **34** no. 3 pp. 316–318, 6 refs. Ottawa, 1954.

DDT (2 μg. per fly) was applied to the labella or to the tibio-femoral membrane of one leg of males of *Musca domestica* L. that had emerged four days before. Treatment of the labella gave 83 per cent. kill in 24 hours, and treatment of the leg gave 68 per cent. When the cervical region of each fly was ligated with cotton thread, the mortality percentages were 91 and only 31 for flies treated on the labella and leg, respectively, and 14 for flies not treated with DDT.

When DDT labelled with ^{14}C was used, and the heads and bodies of the flies were separated 24 hours after treatment and tested for radioactivity, all the radioactivity applied was recovered and the percentages of it recovered from the heads of non-ligated and (in brackets) ligated flies were 70 (98) after treatment on the labella and 5 (less than 1) after treatment on the leg. Radioactivity in the haemolymph of flies treated on the leg could be detected 30 seconds after treatment, rose fairly rapidly during the first five minutes and then remained at a more or less constant level for 24 hours. It is concluded from these results that DDT is translocated in the haemolymph of the fly and that the head is probably a critical region for its lethal action [*cf. R.A.E.*, B **41** 208].

Babers (F. H.) & Roan (C. C.). **Distribution of Radioactive Phosphorus in susceptible and resistant House Flies.**—*J. econ. Ent.* **47** no. 6 pp. 973–975, 9 refs. Menasha, Wis., 1954.

The experiments described were carried out to examine the distribution of phosphorus in house-flies (*Musca domestica* L.) of DDT-resistant and non-resistant strains fed in the larval stage on a diet containing radioactive phosphorus (^{32}P) as potassium acid phosphate. The radioactivity and total phosphorus were determined in trichloroacetic-acid extractives of pupae and adults 12 hours and five days old, in the lipoid fraction and in the residue. The results, which are given in tables, show that the larvae can use inorganic

phosphorus to synthesise phosphates of widely differing chemical natures. The radioactive phosphorus decreased rapidly in the adult flies, except in the lipoid fraction. The biological half-life of the radioactive material was 4·7 days for the trichloroacetic-acid fraction, 5·3 days for the residue, but more than 11 days for the lipoid fraction. There was little difference between the strains. Eggs from flies that had an activity of about 1,000 counts per minute were placed in regular non-radioactive medium and the resulting larvae reared to adults. These had an activity of 11 counts per minute.

Owing to the presence of phosphorus in the food of the adult flies, the older flies contained more total phosphorus than the younger ones. The only significant difference between the strains was shown by the five-day-old females. Those of the resistant strain had less phosphorus, and it is suggested that this may have been due to their oviposition habits, as they were less prolific and oviposited over a shorter period than the susceptible flies.

FAY (R. W.) & LINDQUIST (D. A.). **Laboratory Studies on Factors influencing the Efficiency of Insecticide Impregnated Cords for House Fly Control.**—*J. econ. Ent.* **47** no. 6 pp. 975–980, 1 fig., 2 refs. Menasha, Wis., 1954.

The development of strains of house-flies (*Musca domestica* L.) resistant to halogenated-hydrocarbon insecticides has necessitated the use of other compounds that are either too toxic or have too limited an effective period for application as spray deposits. New ways of using them have had to be found. One of these is to impregnate cords with the insecticide and hang them in the upper parts of infested spaces [*cf. R.A.E.*, B **43** 27]. As the treated cords represent only a small part of the resting surface available, their attractiveness is of great importance, and cage experiments were carried out to study certain attractant factors, as well as to evaluate the effectiveness of various treated cords. The cages, the construction of which is described, were cylinders about 10 ins. long and 5 ins. in diameter and had cellophane sides and wire gauze ends. They provided a variety of resting surfaces for the flies, in addition to one or more cords, and reduced fumigant action to a minimum. Flies on the various cords were counted at intervals during the tests.

Sisal or cotton cords were more attractive than cords of jute or wool, and cotton seemed more suitable than sisal for treatment with dyes or insecticides. Cords of various diameters up to nearly half an inch were compared, and the number of flies per foot was found in general to rise with increase in diameter. Hanging the cords in a horizontal or vertical position made little difference. Red or black cords were preferred to green, blue, yellow or white ones. Treatment with certain chemicals increased the attractiveness of clean cords, but did not make them so attractive as cords soiled by flies. In studies with different population densities and various amounts of cord, the average numbers of flies resting on the cords under each set of test conditions were essentially similar when the factors of population density and linear feet of available cord were considered.

In tests with cords impregnated with xylene solutions of insecticides, in which there were six 10-inch cords per cage, those dipped in 5 or 10 per cent. parathion gave practically complete mortality in 24 hours of DDT-resistant flies with exposure for 60 minutes during a test period of 41 weeks. Cords treated in 5 and 10 per cent. Diazinon [O,O-diethyl O-2-isopropyl-4-methyl-6-pyrimidinyl thiophosphate] gave more than 90 per cent. mortality

for 17 and 26 weeks, respectively, with the same exposure, and those treated in 25 per cent. Diazinon were still giving complete kill after 47 weeks. The Diazinon was shown to be exercising a fumigant action. Diazinon gave more rapid knockdown than parathion, and in a comparative test with 10 per cent. solutions, the knockdown percentages during exposure after 4–12 weeks were 69–75 for parathion, 79–99 and 97–100 for 1:3 and 1:1 mixtures of parathion and Diazinon, and 100 for a 3:1 mixture and Diazinon alone. Parathion and all the mixtures, however, gave high or complete mortality during the 26-week period of the test, whereas Diazinon alone ceased to do so in the 16th week. Of the other insecticides tested on cords, CS-708 [a 1:2 mixture of 1,1-bis(p-chlorophenyl)-2-nitropropane and 1,1-bis(p-chlorophenyl)-2-nitrobutane], DDT, NPD (tetra-n-propyl dithionopyrophosphate), nicotine, A-42 (arsenomethane As-1,2 disulphide) and malathion gave very poor results, and EPN [ethyl p-nitrophenyl thionobenzenephosphonate], Bayer 21/199 [O,O-diethyl O-3-chloro-4-methyl-7-coumarinyl thiophosphate] and Bayer L13/59 [dimethyl 2,2,2-trichloro-1-hydroxyethylphosphonate] showed less promise than parathion or Diazinon.

McKenzie (R. E.) & Hoskins (W. M.). **Correlation between the Length of the larval Period of** *Musca domestica* **L. and Resistance of Adult Flies to Insecticides.**—*J. econ. Ent.* **47** no. 6 pp. 984–992, 2 graphs, 13 refs. Menasha, Wis., 1954.

As it had been observed that strains of *Musca domestica* L. that are resistant to DDT, and also resistant individuals within a strain, had a longer larval period than susceptible ones [*R.A.E.*, B **39** 182], the authors undertook experiments to determine whether successive selection of early and late pupae would result in splitting a strain into two substrains of markedly different susceptibility to DDT. The following is almost entirely based on their summary. A strain moderately resistant to DDT was split into early and late substrains by successive selection of the first half to pupate into one colony and the second half to pupate into a second colony. The period from oviposition to the point when half the pupae had formed decreased slightly in the early substrain and increased about 50 per cent. in the late substrain. The periods from first to last pupation were altered similarly. Resistance of the adults decreased slightly in the early substrain and increased 6–8 times in the late substrain after 15 generations. Changes in susceptibility to DDD were more marked than to DDT, but changes in susceptibility to methoxy-DDT (methoxychlor) were slight, and with lindane [γ BHC], aldrin, dieldrin and pyrethrins, there was no change. Similar but smaller changes occurred with a strain originally highly susceptible to DDT.

Further selection of the late substrain led to a slow decrease in resistance to insecticides of the DDT type, so that after 53 generations, the flies were more susceptible than an unselected control strain. The period from oviposition to the midpoint of pupation decreased simultaneously to about the same as that of the control strain. Susceptibility to pyrethrins was unchanged and susceptibility to aldrin and dieldrin was approximately doubled. General vigour, fertility and length of adult life were not affected.

Selection of long-feeding larvae apparently accentuates two biological factors. One comes to a maximum in a few generations and leads to marked resistance to DDT and related compounds. The other comes on very slowly but ultimately overcomes the first and gives low resistance to the same insecticides. The effect of pyrethrins is unchanged through the whole period of selection. This work shows that significant changes in resistance to DDT

may result from selection of pupae without any exposure to a chemical, and illustrates how unexplained variations in susceptibility of laboratory colonies may come about.

KILPATRICK (J. W.) & SCHOOF (H. F.). **House Fly Control in Dairies near Savannah, Georgia, with residual Applications of CS-708, NPD, and Malathion.**—*J. econ. Ent.* **47** no. 6 pp. 999–1001, 3 graphs, 4 refs. Menasha, Wis., 1954.

The effectiveness of deposits of CS-708 [a 1:2 mixture of 1,1-bis(p-chlorophenyl)-2-nitropropane and 1,1-bis(p-chlorophenyl)-2-nitrobutane], NPD (tetra-n-propyl dithionopyrophosphate) and malathion against house-flies (*Musca domestica* L.) resistant to chlorinated hydrocarbons was studied in dairies near Savannah, Georgia. Emulsions containing 5 per cent. CS-708 and 2 per cent. cottonseed oil with and without 5 per cent. DDT, applied at 200 mg. CS-708 per sq. ft., both gave excellent control for eight weeks, though in the laboratory the formulation without DDT had a very short period of effectiveness. The barn receiving this treatment had a lower fly potential than the other. Emulsions containing 2·5 and 5 per cent. malathion with 12 per cent. sugar at 100 and 200 mg. malathion per sq. ft., respectively, gave excellent initial results and maintained good control for 1–3 weeks. A 2·5 per cent. malathion suspension gave good control for only one week. After five weeks, when it was observed that flies were resting in the untreated feed room, malathion-impregnated cords [*R.A.E.*, B **43** 189] were installed there, and the fly population is estimated to have declined by 25–50 per cent. as a result. Tests with flies in wall cages indicated that malathion deposits from emulsions lost their effectiveness in one week on painted surfaces but retained it for eight weeks on unpainted ones. Formulations containing 2·5 per cent. NPD applied at 100 mg. NPD per sq. ft. were about equal in effectiveness to malathion treatments but showed less lasting toxicity than deposits of CS-708. Malathion and NPD are both suitable for use to give short-term control and have the advantage of low toxicity to mammals.

DELONG (D. M.) & LUDWIG (P.). **Hazards involved when Animals are exposed to organic insecticidal Residues.**—*J. econ. Ent.* **47** no. 6 pp. 1056–1057, 6 refs. Menasha, Wis., 1954.

Fog applications at 2 fl. oz. per 1,000 cu. ft. of sprays containing 1–7 per cent. chlordane, 0·5–2 per cent. lindane [γ BHC], or 5 per cent. Pyrolan (Compound G 22008) (1-phenyl-3-methyl-5-pyrazolyl dimethylcarbamate) were made in rooms the floors of which were covered with a single layer of dog food in small pellets. The rooms were kept closed for several hours. The dog food was then removed and the rooms closed again and used for toxicological tests in which females of *Lucilia* (*Phaenicia*) *sericata* (Mg.) were liberated in them at weekly intervals. Deposits were shown to be about the same on walls, ceiling and floor and averaged less than 5 mg. per sq. ft. Mortality of 71–100 per cent. among the flies, varying with the insecticide and dosage, was obtained for 54 days. White rats that were fed exclusively on the contaminated dog food for five months (consuming 1·2 mg. poisonous deposit per kg. body weight per day) showed no ill effects on autopsy at the end of the period. Rabbits, guineapigs, white rats, mice and poultry were exposed to fog applications of 7 per cent. chlordane without being harmed, and finally the senior author exposed himself to the vapours of

7 per cent. chlordane for 15 minutes at intervals of three days for 12 weeks in 1952 and again in 1953 with no observable toxic effect. These experiments carried out under conditions closely simulating practical treatment failed to provide supporting evidence of the need for the restrictions on the use of certain organic insecticides that have been imposed on the basis of direct feeding or injection tests.

LeRoux (E. J.) & Morrison (F. O.). **The Adsorption, Distribution, and Site of Action of DDT in DDT-resistant and DDT-susceptible House Flies using Carbon^{14} Labelled DDT.**—*J. econ. Ent.* **47** no. 6 pp. 1058–1066, 21 refs. Menasha, Wis., 1954.

The technique of experiments in which radioactive (^{14}C-labelled) DDT was used to study the adsorption, distribution and site of action of DDT in house-flies [*Musca domestica* L.] of a resistant and a susceptible strain [*cf. R.A.E.*, B **42** 139; **43** 188] is described, and the results are given in tables and discussed. The application of droplets of insecticide directly to the inside of the head cavity on the supra-oesophageal ganglion was made possible by the removal of the proboscis at the base and clearing away of the connective membranes that normally block the opening. The operation caused less than 20 per cent. mortality in 24 hours if the flies were kept in a high humidity chamber. Droplets of 1 per cent. DDT in benzene of a size containing about 1·5 μg. DDT were used in most of the tests, but the effect of the same dosage applied over a large or small area of integument was studied by comparing the effects from droplets applied before and after evaporation to a supersaturated state.

The following is almost entirely based on the authors' conclusions. When DDT is topically applied to adult house-flies, the locus of application greatly influences the rate of penetration, distribution and accumulation at the site of action. The DDT is distributed by way of the haemolymph, but not accumulated in it. Other tissues and organs, particularly the integument, absorb the DDT or its metabolites from the haemolymph. The rate at which DDT enters the haemolymph and is distributed to the various parts of the body is directly related to the area of contact. Distribution from the point of application continues at a reduced rate in dead flies. The site of action appears to be some organ or product in or produced within the head of the adult fly [*cf.* **43** 188]. A concentration of 0·05 μg. DDT (or metabolites) in the head resulted in over 50 per cent. mortality in all flies tested. The DDT-resistant strain absorbed externally-applied DDT from all tested loci much more slowly than the non-resistant strain. The effect on both resistant and non-resistant flies of 0·05 μg. DDT applied directly within the head (66 and 84 per cent. kill, respectively) was almost identical with that of 1·5 μg. applied externally on the labella. Resistance appears to be a complex phenomenon attributable to slower penetration and distribution (especially to the head), more rapid elimination in the faeces, and some other factors, which are probably not entirely detoxification factors, since mortality was less in the resistant than in the non-resistant strain, even when the DDT was applied directly to the site of action.

Median lethal doses calculated from the topical application of DDT and estimates of the difference in susceptibility between fly strains are both influenced by the locus of application. The nearer it is to the site of action (in the case of the house-fly the inside of the head), the lower the observed median lethal dose and the less the observed differential in strain susceptibility. The greater susceptibility of individuals treated near or on the site of toxic action offers a method of increasing the sensitivity of bioassay methods.

Acree jr. (F.), Roan (C. C.) & Babers (F. H.). **The Synthesis and Chromatographic Purification of Radioactive Allethrin.**—*J. econ. Ent.* **47** no. 6 pp. 1066–1070, 1 graph, 9 refs. Menasha, Wis., 1954.

The following is the authors' summary. Radioactive allethrin has been synthesised to facilitate a study of the metabolic fate of toxic esters of chrysanthemumic acid after their application to house-flies and cockroaches. After having been purified by chromatography, the radioactive allethrin appeared to be approximately 98 per cent. pure.

Ryckman (R. E.), Lindt (C. C.), Ames (C. T.) & Lee (R. D.). **Seasonal Incidence of Fleas on the California Ground Squirrel in Orange County, California.**—*J. econ. Ent.* **47** no. 6 pp. 1070–1074, 3 graphs, 4 refs. Menasha, Wis., 1954.

Data are given on the seasonal incidence of fleas collected on 258 ground squirrels (*Citellus beecheyi*) over a period of 17 months (August 1951 to December 1952) in a coastal area of south-western California; the ground squirrels belonged to untreated populations that served as controls during experiments with insecticides [*R.A.E.*, B **42** 35]. *Echidnophaga gallinacea* (Westw.) reached its seasonal maximum from August to October, in the hot dry season. It was then numerically dominant. It had a peak index of 66 fleas per ground squirrel in October 1952. The rapid decline that occurred in late October was probably correlated with increased rainfall and an abrupt fall in mean temperature. There are indications that populations are much greater in hotter, drier inland areas. The curve for *Hoplopsyllus anomalus* (Baker) was similar to that for *E. gallinacea* but the population did not reach nearly such a high level. *Diamanus montanus* (Baker) reached its maximum incidence in the cool, moist months of November–February. Its numbers fluctuated less than those of *E. gallinacea* or *H. anomalus*. The seasonal populations of *D. montanus* and *H. anomalus* in general corresponded to those observed in northern California by other workers [**30** 34].

Lewallen (L. L.). **Biological and Toxicological Studies of the Little House Fly.**—*J. econ. Ent.* **47** no. 6 pp. 1137–1141, 1 fig., 7 refs. Menasha, Wis., 1954.

A colony of *Fannia canicularis* (L.) was established from adults and larvae collected on a heavily infested poultry ranch in California. Adults were kept in a screened cage with sides 12 ins. square and wooden front and bottom. Food was introduced and eggs removed through a sleeve attached to the front. The food was a 20 per cent. sugar solution on cotton-wool in a cardboard cup. A cotton-wool pad saturated with a solution of protein hydrolysate in a deep petri dish provided another source of food and served as a medium for oviposition. Pads were most attractive for the latter purpose when two days old. They were removed when they bore 200–300 eggs and put in a large glass jar on a rearing medium containing malt extract and brewer's yeast, in a mixture of milled red wheat bran, a proprietary laboratory food, and water. The jar was covered with muslin. The larvae pupated around the edge and on top of the medium, and the adults emerged in the jars and were transferred to a cage.

All stages of the fly are briefly described, and notes on its bionomics are given. The egg, larval and pupal stages lasted 36–48 hours and 8–10 and 8–12 days, respectively, at 80° F. and 65 per cent. relative humidity. The preoviposition period in the cage was 4–5 days. In nature, the males fly about

apparently aimlessly for long periods at a time, but the females fly less. Both rest on the walls and ceilings of farm buildings as well as out of doors on walls or vegetation, so that insecticide deposits might be effective against them. The fly disappears in summer in areas where very high temperatures are reached [*cf. R.A.E.*, B **23** 222]. In toxicity studies in which measured drops of insecticide were applied topically to the adults, the median 24-hour lethal doses in μg. per fly for females of *F. canicularis* and (in brackets) for females of a non-resistant strain of *Musca domestica* L. were 2·8 (0·033) for DDT, 0·14 (0·068) for methoxy-DDT (methoxychlor), 0·76 (0·01) for γ BHC as lindane, 0·003 (0·031) for dieldrin, 0·24 (1) for pyrethrins, 0·1 (0·56) for malathion, 0·098 (0·092) for Diazinon [O,O-diethyl O-2-isopropyl-4-methyl-6-pyrimidinyl thiophosphate] and 0·035 (0·33) for chlorthion (O,O-dimethyl O-3-chloro-4-nitrophenyl thiophosphate). The males of *F. canicularis* were more susceptible than the females to all the synthetic insecticides, but the median lethal dose of pyrethrins for them was 0·44 μg.

Lee (R. D.). **First Report of the Poultry Bug from a Golden Eagle's Nest, with new Locality Records.**—*J. econ. Ent.* **47** no. 6 p. 1144, 3 refs. Menasha, Wis., 1954.

Several previously unpublished locality records and all previously published county records are given for *Haematosiphon inodorus* (Dug.) in the United States. The States involved are Texas, New Mexico, California, Arizona and Oklahoma. Birds other than poultry from the nests of which the bug has previously been recorded are a condor and owls [*R.A.E.*, B **37** 184]. It is now reported from the nest of a golden eagle in Texas. These records indicate that it is associated with birds of prey rather than passerines [*cf. loc. cit.*].

Hoekstra (W. G.), Dicke (R. J.) & Phillips (P. H.). **Use of wettable Powder or Emulsion Formulations compared with Mineral Seal Oil on Calves.**—*J. econ. Ent.* **47** no. 6 pp. 1144–1145, 4 refs. Menasha, Wis., 1954.

As it had been observed that topical application of an oil-based insecticide carrier caused a hyperkeratosis or skin-thickening in calves, whether or not insecticides were added to it [*cf.* also *R.A.E.*, B **33** 66], an experiment was carried out in 1953 to compare the effects of sprays of mineral seal oil and four insecticide formulations. Twelve calves were used, a pair for each treatment and a pair as the control, and the sprays were applied three times a week for 12 weeks. The oil was applied at 65 ml. per calf. The insecticide sprays, which comprised three wettable-powder suspensions and one emulsion of a proprietary concentrate and were applied at much higher rates, had no detectable effect on the appetite, growth, general condition or skin of the calves. Blood plasma vitamin A concentrations, which fall when classical bovine hyperkeratosis induced by ingestion of chlorinated naphthalenes is present, did not become significantly different from those of the control calves. A definite hyperkeratosis developed along the neck and shoulders of the calves treated with the oil, but their appetite was not seriously affected nor was growth greatly retarded. A slight transitory depression in the plasma vitamin A occurred upon application of the oil, but it appeared not to be critical. In view of these results, it is necessary to recommend wettable-powder or emulsion formulations for direct application to calves until the problem of hyperkeratosis and petroleum oils has been solved.

Hoffman (R. A.). **The Effectiveness and Limitations of homemade Self-treatment Rubbing Devices for Louse Control on Cattle.**—*J. econ. Ent.* **47** no. 6 pp. 1152–1153, 3 refs. Menasha, Wis., 1954.

Further experiments with home-made devices enabling louse-infested cattle to rub themselves against burlap impregnated with insecticide were made in Oregon in the winter of 1953–54 [*cf. R.A.E.*, B **43** 117]. Two types of rubbing unit were employed, the single-pole tightly strung type [*loc. cit.*] and the two-pole loose-cable type [**40** 131]; the cattle used both readily, but the tightly strung type required more frequent repair. *Damalinia* (*Bovicola*) *bovis* (L.), *Linognathus vituli* (L.) or both were present on the test cattle and *Damalinia* was more easily controlled, but the degree of control obtained seemed to depend on the characteristics of the site rather than the species of louse, type of unit or insecticide used. It was poor in muddy or brushy areas or where there were many trees. On dry ground, 94 per cent. control or better of each species of louse was achieved in three weeks. The insecticides were DDT, toxaphene, chlordane and methoxy-DDT (methoxychlor), all used at 5 per cent. in fuel oil and applied at 150 ml. solution per foot at the start of the test and 50 ml. three weeks later. All gave good control in at least one test under favourable conditions, but failed under adverse conditions. DDT was also used at 2·5 per cent. and at this strength gave complete control in six weeks in a favourable situation. Methoxy-DDT is the only insecticide of the four that is recommended for use on milch cows. Cattle used units on open ground more readily than those across the corners of fences, but showed no preference between units under cover and those in the open. Control was obtained under both conditions and it appeared that leaching of insecticide solution by rain was slight.

Cross (H. F.) & Wharton (G. W.). **Techniques for testing the Attachment and Feeding Rate of Mites on Living Hosts.**—*J. econ. Ent.* **47** no. 6 pp. 1153–1154, 2 refs. Menasha, Wis., 1954.

Cross (H. F.). **Feeding Tests with Blood Sucking Mites on Heparinized Blood.**—*T. c.* pp. 1154–1155, 1 ref.

Devices are described in the first paper that make it easy to place mites on the shaved skin of an anaesthetised host and confine them there under a vial. Small differences in behaviour were distinguished in this way. The percentage of larvae of *Trombicula splendens* Ewing that had attached 45 minutes after they had been put on white mice was 88, whereas only 58·9 per cent. of larvae of *T. alfreddugèsi* (Oudm.) had attached. After exposure for 30 minutes on white rats at 75, 85 and 95°F., the percentages of nymphs of *Bdellonyssus bacoti* (Hirst) that had engorged were 24·1, 77·4 and 100, respectively.

In the second paper, a method is described of feeding Laelaptid mites on heparinised blood. It resulted from the observation that *Bdellonyssus bursa* (Berl.) would engorge on blood absorbed in cotton. The mites are put into a small tube covered at each end with bolting silk, and the silk over one end is pressed into the tube and held there by inserting a rubber ring of the same external diameter as the inside of the tube and about 4 mm. deep. Heparinised blood was introduced into the ring, and the mites were allowed to feed for a given time through the silk. When nymphs of *B. bacoti* were fed by this method, the percentages that engorged on rat blood in 30 minutes at 75, 85 and 95°F. were 34·6, 65 and 100, respectively. *Dermanyssus gallinae* (Deg.), *B. bursa* and *Fonsecaonyssus* (*B.*) *sylviarum* (C. & F.) also fed successfully. It is believed

that all these species could be reared on blood. The amount of heparin necessary depends on the rate at which the mites feed; some species can engorge sufficiently on untreated blood.

Fletcher (D. S.). **A synonymic Revision of the Genus *Arcyophora* Guenée.**—*Proc. R. ent. Soc. Lond.* (B) **23** pt. 11–12 pp. 197–200, 5 refs. London, 1954.

Reid (E. T. M.). **Observations on Feeding Habits of Adult *Arcyophora*.**—*T. c.* pp. 200–204, 4 refs.

The revision that is the subject of the first paper was undertaken because moths of the Agrotid subfamily Westermanniinae received in 1953 from the Sudan, where they had all been taken feeding on the lachrymal secretions of cattle, were identified as *Arcyophora longivalvis* Guenée, *Setoctena patricula* (Hmps.) and *Gonioxestis zanderi* (Felder). It seemed unlikely that such specialised feeding habits would be shared by members of three genera, and a study of the genitalia and other characters of nearly all the species that had been included in them resulted in their being regrouped in two closely related sections of *Arcyophora* (*Arcyophora* and *Setoctena*), which can be separated by wingspan and the structure of the male genitalia. A key is given to the species of the genus. There is also a list of the synonyms of *Arcyophora* and one of the included species with their synonyms, showing which of the latter are new, and including citations of the original references and indications of known distribution.

Reid describes the feeding habits of adults of *A. longivalvis*, *A. patricula* and *A. zanderi* as observed by himself in the southern Sudan and summarises observations by previous workers. They were found in well-wooded country in the Sudan and were nocturnal. All three were taken from the eyes of cattle, horses and donkeys. The probing of the proboscis in the eye caused blinking and greatly increased lachrymation. Clear fluid was exuded from the anus of the moths during feeding. *A. longivalvis* had previously been taken feeding at the eyes of mules in Tanganyika and cattle in South Africa, and *A. patricula* at the eyes of cattle in Uganda, where it suddenly appeared in numbers round the eyes of an animal that was being used as a bait for *Glossina* at night, doing so a minute or two after a herd of buffalo had been stampeded nearby. It is suggested that these moths may spread some forms of ophthalmia or be mechanical vectors of virus diseases that are spread among cattle or from game to cattle in the secretions and excretions of infected animals.

Rathnaswamy (G. K.) & Ramakrishnan (N. R.). **Report on a Sandfly Survey of Madras City.**—*Indian J. Ent.* **16** pt. 1 pp. 29–36, 1 map, 11 refs. New Delhi, 1954.

Visceral leishmaniasis (kala-azar) has long been prevalent in Madras City and there is evidence that it has increased during the past 20 years. It occurs throughout the year with no marked seasonal peak, but is almost confined to older and more crowded parts of the city, which form a single endemic area.

Seven species of *Phlebotomus* were collected in the city during 1951–53, of which six were obtained during a systematic survey carried out from November 1951 to October 1952. They included *P. papatasi* (Scop.) and *P. argentipes* Ann. & Brun. [which were the only members of the subgenus *Phlebotomus*] and these two made up 2,905 and 298 of the 5,020 sandflies collected in the survey, when 926 man-hours were expended in the examination of 6,565 structures. *P. argentipes*, the presumed vector of visceral

leishmaniasis, was not evenly distributed; divisions in which it was plentiful and others in which it was not occurred both within and outside the endemic area. In general, the sandflies were most numerous in mud-walled and thatched dwellings and rested in cool, dark corners. Few were found in animal shelters. All species except *P. papatasi* were caught mostly within five ft. of the ground.

Dissection of 74 females of *P. argentipes*, 664 of *P. papatasi* and 131 of other species failed to reveal any leptomonad forms. Rhabdidiform larvae were occasionally found in *P. argentipes* and *P. papatasi* and larvae of *Mermis* in blood from the abdomen of one female of *P. papatasi*, while microfilariae of *Wuchereria bancrofti* were observed frequently in the females of *P. papatasi* that had been collected in two divisions of the city in which this filaria is endemic and is transmitted by *Culex pipiens fatigans* Wied. Various mites were found attached to the sandflies.

Basu (B. C.), Balarama Menon (P.) & Sen Gupta (C. M.). **Field Studies on the Bionomics of *Tabanus* Flies with a View to work out Control Measures.**—*Indian J. Ent.* **16** pt. 1 pp. 67–76, 14 figs., 1 map, 9 refs. New Delhi, 1954.

In view of the need for devising measures for the control of species of *Tabanus* that are vectors of surra [*Trypanosoma evansi*] in India [*cf. R.A.E.*, B **43** 181], an investigation of the bionomics of members of this genus was begun in August 1950. It was carried out in villages near Bareilly (Uttar Pradesh), which were chosen because they were situated on river banks or near large ponds or canals and were easily accessible by road. They are in an area crossed by numerous streams, where irrigation is extensively practised. Each village was generally surveyed monthly for all stages. The most common species found were *Tabanus rubidus* Wied., *T. striatus* F., *T. macer* (Big.) and *T. virgo* Wied. There appeared to be at least two generations a year with oviposition in spring and after the monsoon. Egg masses, which were deposited on vegetation overhanging water, contained 159–380 eggs, generally in several layers. A list is given of the nine plants on which all species oviposited profusely. Larvae were found in damp soil and under stones bordering ponds and streams, in mud and wet, rotting logs. In two out of five areas studied, the egg masses were heavily attacked by a small Hymenopterous parasite, which appeared to have no specific preferences, eggs of *T. rubidus* and *T. macer* being parasitised almost equally. During March–May and October, when it was most prevalent, nearly all the eggs in most of the egg batches in the areas were parasitised. Studies on the identity and bionomics of the parasite and the possibility of using it to control *Tabanus* are in progress.

Pictorial Keys to the Mosquitoes of medical Importance.

Sommerman (K. M.). **I. Korea.**—*Mosq. News* **13** no. 1 pp. 18–20, illus. Albany, N. Y., 1953.

Sommerman (K. M.) & Foote (R. H.). **II. Formosa.**—*T. c.* pp. 20–22, illus. **III. Malaya.**—*T. c.* no. 2 pp. 162–164, illus.

Foote (R. H.). **IV. Anglo-Egyptian Sudan.**—*T. c.* no. 4 pp. 255–258, illus.

These are the first four of a proposed series of pictorial keys, designed to help in the rapid determination of mosquitos of primary medical importance and their larvae in various parts of the world. The species of *Anopheles* that are the principal vectors of malaria are included in each key, together

with mosquitos that are known to transmit or are suspected of transmitting other diseases. The keys are so constructed that unimportant species known to occur in the area are eliminated from consideration. Species that are not known to be present in a given area but might be found there are sometimes included. There are very brief notes on the importance and habits of the included species, and lists of the species of *Anopheles* known or believed to be present but of insufficient importance for inclusion in the keys.

KNIGHT (K. L.). **Hybridization Experiments with** *Culex pipiens* **and** *C. quinquefasciatus* **(Diptera, Culicidae).**—*Mosq. News* **13** no. 2 pp. 110–115, 2 figs., 8 refs. Albany, N. Y., 1953.

The following is almost entirely based on the author's summary. This study was made to determine the effect of backcrossing upon hybrid stocks obtained by crossing Egyptian *Culex pipiens* L. [*cf. R.A.E.*, B **41** 206] and *C. p. fatigans* Wied. (*quinquefasciatus*, auct.). The *pipiens* adults used were reared from larvae and pupae collected in a single breeding place in Cairo and the *fatigans* adults belonged to a colony from Asmara, Eritrea. The first backcross was accomplished in all possible combinations. The second backcross was made in four combinations. Two morphological characters, one adult and one larval, were used to evaluate the effects of hybridisation. The results indicate that if backcrossing is allowed to take place, hybrid stocks of *pipiens* × *fatigans* will revert in 2–3 generations to the parent type. This reversion requires about one generation less with *pipiens* than with *fatigans*.

BRENNAN (J. M.) & HARWOOD (R. F.). **A preliminary Report on the laboratory Colonization of the Mosquito,** *Culex tarsalis* **Coquillett.**—*Mosq. News* **13** no. 2 pp. 153–157, 1 fig. Albany, N. Y., 1953.

A method is described by which a colony of *Culex tarsalis* Coq., a eurygamous species, was successfully established in the laboratory at Hamilton, Montana. When in about the tenth generation, the colony was still in a flourishing condition and had shown no tendency to diapause. It was maintained throughout the whole life-cycle in a metal-screen cage 7 ft. high, 6 ft. long and 4 ft. wide. For a conditioning period, lighting, temperature and humidity simulated as nearly as possible the conditions that appeared to favour swarming in the neighbourhood. The source of light was entirely artificial. A day period of 16 hours and a night period of about 6 hours were separated by dusk and dawn periods of one hour each, during which the light intensity was changed gradually and suitable adjustments were made to temperature and humidity. Swarming and pairing occurred during these periods, but chiefly during the dusk one. After six generations, it was possible to use constant temperature and humidity and eliminate the dawn period without endangering the colony. About 75 per cent. of all egg rafts contained viable eggs.

HALL (R. R.), DOWNE (A. E. R.), MACLELLAN (C. R.) & WEST (A. S.). **Evaluation of Insect Predator-Prey Relationships by Precipitin Test Studies.**—*Mosq. News* **13** no. 3 pp. 199–204, 8 refs. Albany, N. Y., 1953.

An account is given of the technique used and results obtained in the experimental determination of the identity of the insects on which a

predatory insect has fed by means of the precipitin test. Cell-free extract for use as an antigen was prepared by starving insects of the species expected to be the prey to allow the gut to empty, washing them and macerating them with an equal volume of buffered physiological saline. The mixture was refrigerated at 8°C. [46·4°F.] for 48 hours, filtered through a Buchner funnel, sterilised by passage through a Seitz filter and bottled. Merthiolate preservative was added to give a final dilution of 1:10,000, and the antigen was stored at 8°C. until required for use. Four successively increasing amounts of the antigen were then injected into a rabbit, which was bled for antiserum after the titre was found to be suitable. Antisera were Seitz-filtered and stored at −25°C. [−13°F.]. The titre was determined as the highest dilution of the antigen that gave a positive ring test with a constant dilution of antiserum. Titres of at least 1:5,000, using undiluted antiserum, were desirable for predator studies. Smears of the whole predator or its gut contents (or of the prey for positive controls) were made on filter paper and could be stored indefinitely in envelopes. For testing, the smear was soaked in a small amount of buffered physiological saline, some of the extract was underlayered in a test-tube with an equal volume of antiserum, the titre of which had been checked after thawing, and the tube was incubated at 37°C. [98·6°F.] for one or two hours. In positive tests, a precipitin ring appeared at the interface. The reaction is not specific, however; in studies of associations in which Lepidopterous larvae were the prey, cross-reactions between antisera and smear extracts occurred when the larvae concerned belonged to different species of the same genus or even to two very closely related families.

Brief mention is made of similar studies on other predator-prey associations. These included larvae of a species of Megaloptera known to have preyed on Chironomid larvae. The Chironomid antiserum revealed the presence of Chironomid antigen in the gut of a predator for as long as four days when the predator larvae were kept at water temperatures of 16–24°C. [60·8–75·2°F.]. A possible use of cross-reactions was also demonstrated in that, when the supply of Chironomid antiserum was exhausted, reactions could be obtained with a mosquito-larva antiserum, though the predators had not fed on mosquito larvae. The antiserum had a homologous titre of 1:10,000 and a heterologous titre of 1:1,500 with Chironomid antigen. Smears of known or suspected predators of mosquito larvae from northern Canada were titrated against a mosquito-larva antiserum, and positive reactions were obtained with Dytiscid larvae and adults and with larvae of Trichoptera. No positive reactions were obtained with snails [*cf.* next abstract]. Smears of Chaoborine larvae, which are commonly observed predators of mosquito larvae near Churchill, Manitoba, could not usefully be examined, as they usually reacted positively with the mosquito-larva antiserum on account of the close relationship. Theoretically a tribe-specific antiserum could be prepared by absorption.

Downe (A. E. R.) & West (A. S.). **Progress in the Use of the Precipitin Test in Entomological Studies.**—*Canad. Ent.* **86** no. 4 pp. 181–184. 7 refs. Ottawa, 1954.

Examples are given of the use of the precipitin test in Canada for identifying the sources of blood-meals of mosquitos and also for determining the rate of digestion of blood in them [*R.A.E.*, B **41** 209] and for identifying the prey of predators [see preceding abstract]. An important advance in technique made in studies on predators of mosquito larvae near Churchill, Manitoba, has been the demonstration that low-titre (1:100) but avid antisera will detect mosquito antigen in predator smears. Since one of the

greatest difficulties has been the production of high-titred insect antisera, this discovery has removed a major hindrance to the extensive application of the precipitin test to predator studies. It has also been shown that whereas adults of large species of Dytiscids regularly feed on mosquito larvae, those of smaller species do not. Gerrid adults are consistent predators on mosquito larvae. Larvae of Trichoptera seldom prey on mosquito larvae early in the season, but do so regularly when the latter are nearly full-grown. Several positive smears were obtained with a snail, which was also observed preying on mosquito larvae in the field.

Marshall (I. H.). **Hemorrhagic Fever. I. Epidemiology.**—*Amer. J. trop. Med. Hyg.* **3** no. 4 pp. 587–600, 2 figs., 19 refs. Baltimore, Md., 1954.

Dews (S. C.) & Marshall (I. H.). **II. Prevention.**—*T. c.* pp. 601–607, 1 fig., 2 refs.

In the first paper, the epidemiology of haemorrhagic fever is discussed on the basis of information from 2,070 cases (with 122 deaths) that occurred among United Nations forces in Korea between 11th April 1951 and 28th January 1953. Though the causal agent has not been isolated, available data strongly suggest that it has a rodent reservoir and mite vector [*R.A.E.*, B **43** 161]. The most abundant Murid seemed to be *Apodemus agrarius*. Trombiculids collected on field rodents showed a seasonal incidence that indicated them as probable vectors [**43** 162], but mites were not recovered from men having symptoms of the disease, and patients showed no evidence of having been attacked by Trombiculids.

In the second paper, an account is given of measures taken to prevent the spread of the disease among the troops. These were the individual use of a standard insect repellent, treatment of clothing and sleeping bags with a repellent acaricide, spraying of tents and bunkers against mites with 1 per cent. γ BHC (lindane) in emulsified solution and limited area control of rodents by poisoning and trapping. The predominant rodent was *A. a. coreae* and it readily entered bunkers and tents. The repellent acaricide was a concentrate consisting of dimethyl phthalate, dibutyl phthalate, benzyl benzoate or various combinations of them, with an emulsifier. It was diluted with water to a concentration of 1:17 for treatment of clothing by dipping or 1:10 for spraying the outer covers of sleeping bags. Dipping the clothes was the only effective method of treating them; application by hand or as a spray, used when dipping was impracticable, did not afford adequate protection. Treatment at least monthly or after every third washing was required. The problems of organising the control measures under service conditions in a field army are discussed.

Rodent control by poisoning was immediately and continuously successful. It was difficult to evaluate the effectiveness of the various measures, but there were indications that the wearing of dip-impregnated clothing by most of the troops reduced the number of cases by over 70 per cent. in one standard population of the United States army for which comparative data were available. Personal protection by the use of treated clothing is deemed to be the most important measure.

Jeffery (G. M.), Young (M. D.) & Wilcox (A.). **The Donaldson Strain of Malaria. 1. History and Characteristics of the Infection in Man.**—*Amer. J. trop. Med. Hyg.* **3** no. 4 pp. 628–637, 10 refs. Baltimore, Md., 1954.

Wilcox (A.), Jeffery (G. M.) & Young (M. D.). **2. Morphology of the erythrocytic Parasites.**—*T. c.* pp. 638–645, 4 pls., 9 refs.

Jeffery (G. M.). **3. The Infection in the Mosquito.**—*T. c.* pp. 651–659, 1 graph, 9 refs.

Jeffery (G. M.) & Young (M. D.). **4. An Evaluation and Status.**—*T. c.* pp. 660–664, 5 refs.

A strain of malaria presumed at the time to be *Plasmodium vivax* was recovered in June 1949 from Dr. Alan W. Donaldson, who had been on service in areas in the western Pacific during 1944–45 and had probably contracted the infection in the Philippines. It was found, when used to inoculate patients needing malaria therapy, to differ considerably from strains of *P. vivax* then in use. Intensive study showed that clinically it resembled *P. ovale*, and morphological studies of the erythrocytic stages confirmed that it belonged to this species. Females of *Anopheles quadrimaculatus* Say and of Florida and Panama strains of *A. albimanus* Wied. all acquired infection with the Donaldson strain by biting, *A. quadrimaculatus* being the most easily infected, both as regards infection rate and number of oöcysts, and Panama *albimanus* the least. No close relationship was found between day of parasite patency or total density of erythrocytic parasites and infectivity to mosquitos. There were indications of alternating periods of high and low infectivity. A positive correlation was observed between the density of male gametocytes and infectivity to mosquitos. The cycle in the mosquito was completed in an average of 15 days at 77°F. The similarities between the characteristics observed and those of *P. ovale* are discussed.

P. ovale has never become established in the United States so far as is known, but as it is immunologically distinct from native strains of *P. vivax*, and can infect white and coloured people and native species of *Anopheles*, it could presumably become established should conditions be favourable.

Herman (C. M.), Reeves (W. C.), McClure (H. E.), French (E. M.) & Hammon (W. McD.). **Studies on Avian Malaria in Vectors and Hosts of Encephalitis in Kern County, California. I. Infections in Avian Hosts.**—*Amer. J. trop. Med. Hyg.* **3** no. 4 pp. 676–695, 31 refs. Baltimore, Md., 1954.

Reeves (W. C.), Herold (R. C.), Rosen (L.), Brookman (B.) & Hammon (W. McD.). **II. Infections in Mosquito Vectors.**—*T. c.* pp. 696–703, 10 refs.

Rosen (L.) & Reeves (W. C.). **III. The comparative Vector Ability of some of the local Culicine Mosquitoes.**—*T. c.* pp. 704–708, 4 refs.

The investigations on avian malaria described in these papers were made in Kern County, California, from 1946 to 1951, because it was thought that the information acquired would be pertinent to studies of the mosquito vectors and avian hosts of the arthropod-borne encephalitis viruses that occur there [*cf. R.A.E.*, B **38** 193; **39** 101–103, etc.]. The following is based on the authors' summaries.

Examination of 10,459 blood smears from 8,674 birds representing 73 species resulted in the observation of *Plasmodium* in 1,094 smears representing 888 individual birds of 27 species. At least seven species of *Plasmodium* were found, and new host records are made for most of them. *P. praecox* (*relictum*) was observed far more frequently than all the others and occurred in at least 79 per cent. of the infected birds. Parasites believed to be *P. rouxi*, which has not previously been recorded outside

Algeria, were found in two new hosts. The inoculation of blood from wild birds into canaries led to the demonstration of many infections not observed on blood-smear examination of donors.

To determine the natural vectors, 3,364 mosquitos were examined for parasites during the summers of 1946, 1947, 1949 and 1950, and infection was demonstrated in 9·6 per cent. of 2,074 females of *Culex tarsalis* Coq., 15·6 per cent. of 180 of *C. stigmatosoma* Dyar, and 1·9 per cent. of 746 of *C. pipiens fatigans* Wied. (*quinquefasciatus*, auct.). The differences are believed to reflect variation in vector efficiency. No infection was found in 82 females of *Aëdes nigromaculis* (Ludl.), 43 of *A. dorsalis* (Mg.), 27 of *Anopheles freeborni* Aitken or seven of *A. punctipennis* (Say), but two of 205 of *Anopheles pseudopunctipennis franciscanus* McCracken contained what appeared to be young oöcysts of some unidentified malaria parasite. The intensity of infection in the principal vector, *C. tarsalis*, varied considerably in different years and areas. The variations are believed to be due to such factors as climate, the effect of mosquito control on the vector population and ecological differences between areas. *P. praecox* was isolated from naturally infected females of *C. tarsalis* and *C. stigmatosoma*. *C. tarsalis*, *C. stigmatosoma* and *C. p. fatigans* were all experimentally infected with local strains of *P. praecox* and transmitted them to canaries. The first two were more easily infected than the last. This provides an explanation for the difference in natural infection rates observed.

Rosen (L.). **Human Filariasis in the Marquesas Islands.**—*Amer. J. trop. Med. Hyg.* **3** no. 4 pp. 742–745, 15 refs. Baltimore, Md., 1954.

On a visit to the six inhabited islands of the Marquesas group in June 1952, the author observed that at least 5 per cent. of the population of each island had gross manifestations of elephantiasis, and 19 of 59 stained blood-films taken in the daytime from inhabitants of one island, including some people who had never left it, were positive for microfilariae of *Wuchereria bancrofti*. *Aëdes polynesiensis* Marks was found on all six islands [*cf. R.A.E.*, B **42** 161], though two of them did not have rats that could open coconuts. The rat-opened coconut is the most important breeding site of *A. polynesiensis* in the Society Islands [*cf.* **42** 90, 91]. The Marquesas form the north-eastern limit of the distribution of endemic filariasis and of mosquitos of the group of *A. scutellaris* (Wlk.) in the Pacific Area. Historical data are given indicating that *W. bancrofti* and *A. polynesiensis* have both become established in the Marquesas since the beginning of European influence in Polynesia.

Rozeboom (L. E.) & Gilford (B. N.). **The genetic Relationships of *Aedes pseudoscutellaris* Theobald and *A. polynesiensis* Marks (Diptera: Culicidae).**—*Amer. J. Hyg.* **60** no. 2 pp. 117–134, 6 figs., 36 refs. Baltimore, Md., 1954.

Experiments on hybridisation between closely-related mosquitos, and the evidence they provide as to whether or not different populations are specifically distinct, are reviewed [*cf. R.A.E.*, B **43** 98], the mechanisms of inheritance in mosquitos, and the data that have led some workers to conclude that cytoplasmic factors may be of importance [**43** 49, etc.], are briefly discussed, and an account is given of experiments already briefly noticed [**43** 99] on crossbreeding of *Aëdes pseudoscutellaris* (Theo.) and *A. polynesiensis* Marks belonging to colonies established with material from Fiji and American Samoa, respectively. These populations differ from one

another in two small morphological characters [**41** 161] and certain physiological ones. *A. polynesiensis* was more vigorous and easier to maintain. Females of both transmitted *Plasmodium gallinaceum* from fowl to fowl, but the percentages that became infected when they were fed simultaneously on the same infected bird were 45·1 in *pseudoscutellaris* and only 4·3 in *polynesiensis*.

Fertile hybrid progeny of both sexes were readily obtained from crosses in both directions. Cross-fertilised parent females and hybrid females could produce as many eggs as the controls. Percentage hatch of F_1 hybrid eggs was reduced, but the F_2 and F_3 hybrid eggs were nearly as fertile as the controls. Viability of hybrid larvae and pupae resembled that of *polynesiensis* controls. When given a choice of females, males of *polynesiensis* inseminated 72 per cent. of the females of their own kind and 19·5 per cent. of an equal number of *pseudoscutellaris*, whereas *pseudoscutellaris* males inseminated 51·1 per cent. of females of *polynesiensis* and 42·9 per cent. of those of their own kind. The differences were significant. It is thought that they were due not so much to ability of the sexes to recognise their own kind, as to differences in sexual activity [*cf.* **43** 68].

Most of the hybrids were intermediate morphologically between the parents, and it appeared that inheritance of the distinguishing characters was controlled by the chromosomes. No evidence of cytoplasmic inheritance was discovered. As no effective genetic barrier was found between *A. polynesiensis* and *A. pseudoscutellaris* in the laboratory [*cf.* also **42** 161], the authors consider that they cannot be regarded as true species, unless a definite mating barrier can be demonstrated in nature. Unless they can be shown to be microgeographically allopatric in Fiji, where they coexist, they may have to be relegated to a lower category than subspecies.

Attempts to crossbreed *A. polynesiensis* and *A. aegypti* (L.) showed that mating can take place only with great difficulty and even if insemination were accomplished, it would probably not result in fertilisation of the eggs.

Wallis (R. C.). **A Study of Oviposition Activity of Mosquitoes.**—*Amer. J. Hyg.* **60** no. 2 pp. 135–168, 2 figs., 58 refs. Baltimore, Md., 1954.

Accounts in varying detail are given of the oviposition activity of *Aëdes aegypti* (L.), *A. polynesiensis* Marks, *A. pseudoscutellaris* (Theo.), *Anopheles quadrimaculatus* Say, *A. freeborni* Aitken, *A. aztecus* Hffm., *Culex pipiens pipiens* L., *C. p. fatigans* Wied. (*quinquefasciatus*, auct.). *C. p. molestus* Forsk., and *C. salinarius* Coq. as observed in the laboratory when studied by methods that are described. Females of all these mosquitos were clearly shown to exercise selection in the choice of oviposition sites. When distilled water and water containing 1, 2, 3, 4, 5 and 6 per cent. salt (sodium chloride) were offered, nearly all females of *Aëdes* and *Culex* oviposited in the distilled water, though 5·4 per cent. of *A. aegypti* and 8 per cent. of the brackish-water species, *C. salinarius*, and occasional individuals of some of the others laid in water containing 1 per cent. salt. The Anophelines also showed a decided preference for distilled water, but eggs of all three were collected on water of all salinities up to 4 per cent. Some error may have been involved owing to eggs being laid in flight. In the absence of distilled water or water of low salinity, only the Anophelines readily accepted water of high salinity. A salt concentration of 6 per cent. (the highest offered) was accepted by all three species. Further tests in which a choice of distilled water and various low concentrations of salt solution were offered to the *Culex* and *Aëdes* mosquitos confirmed that they exercise definite preferences within the range. The fresh-water *Culex* preferred distilled water and rejected all water with more than 1 per cent.

salt [*cf. R.A.E.*, B **41** 61]. *C. salinarius* showed little preference between distilled water and water containing up to 0·75 per cent. salt, but ignored water with more than 1·5 per cent. salt. *A. aegypti* and *A. polynesiensis* showed a definite preference for water containing 0·25 per cent. salt and *A. pseudoscutellaris* for distilled water.

The following is virtually the author's summary of experiments on the location of the sensory areas. Females with abdominal movement restricted so that contact between the ovipositor and test solution was impossible, could still detect objectionable amounts of salt in oviposition sites. Likewise, surgical removal of the palpi, proboscis and antennae did not result in loss of sensitivity. Surgical removal and wax coating of various combinations of legs and leg segments resulted in the demonstration that sensitivity was localised in the tarsal segments of all ten kinds of mosquitos. Further investigation of the tarsi of *A. aegypti* showed that sensitivity was present in all tarsal segments. The distribution of curved thin-walled spines similar to chemoreceptive structures of other insects was correlated with the extent of sensitive areas. These areas enable the mosquito to detect differences in salt concentrations as small as 0·02 M. Such evidence suggested that mosquitos distinguish chemical differences in oviposition sites by using contact chemoreceptive spines on the tarsi.

INGRAM (R. L.). **A Study of the Bionomics of** *Aedes* (*Stegomyia*) *polynesiensis* **Marks under Laboratory Conditions.**—*Amer. J. Hyg.* **60** no. 2 pp. 169–185, 2 figs., 14 refs. Baltimore, Md., 1954.

An account is given of studies of certain aspects of the biology of *Aëdes polynesiensis* Marks made under controlled conditions on a laboratory colony established from Samoan material. The following is mainly based on the author's summary. Four days were required for the completion of embryonic development, after which the eggs could be dried for 30 days or longer and remain viable. Reduced oxygen content of the water was a positive stimulus to hatching, but mechanical agitation was not. Undried eggs continued to hatch for 72 days. At temperatures of 70, 80 and 90°F., larvae completed their development in 9·6, 6·5 and 4·6 days, and pupae in 3·7, 2·2 and 1·8 days, respectively. Few first-instar larvae survived out of water, but survival increased in the later instars, and many in the fourth instar were alive after four days and pupated when returned to normal conditions. Stranded pupae produced viable adults. Mortality of larvae that hatched and developed in solutions containing 0·25 or 0·5 per cent. sodium chloride was not higher than in controls, though the 0·5 per cent. solution increased the duration of the larval stage. Some larvae completed their development in a 1 per cent. solution, but those that hatched in a 1·5 per cent. solution died immediately. A small proportion of larvae transferred to a 1·5 per cent. solution when they were 1–2 days old survived to pupate, but only a few of the pupae produced adults. Tolerance of this concentration by older larvae increased with their age. High acidity or alkalinity (pH 4 or 9–10) was detrimental to the larvae and pupae. Length of adult life was directly correlated with temperature at optimum relative humidity. The maximum was 100 days. At temperatures of 70, 80 and 90°F., 50 per cent. of the females were alive after 50, 31 and 17 days, respectively, and 50 per cent. of the males after 44, 23 and 14 days. Females took blood three or four days after emergence, oviposited four days after each blood-meal and fed again about three days after oviposition. They took as many as six blood-meals. The mean number of eggs produced per meal was 72 ± 5 and the mean total per female was 230 ± 26.

Jachowski jr. (L. A.). **Filariasis in American Samoa. V. Bionomics of the principal Vector, *Aedes polynesiensis* Marks.**—*Amer. J. Hyg.* **60** no. 2 pp. 186–203, 4 figs., 17 refs. Baltimore, Md., 1954.

Observations on the bionomics of *Aëdes polynesiensis* Marks were made in the field in American Samoa in 1948–50 [*cf. R.A.E.*, B **42** 91] and supplemented by investigations on a laboratory colony that has been established at The Johns Hopkins University in Maryland and was also the source of the material of this species used in other work [see three preceding abstracts]. Hourly collections of biting females throughout the 24 hours at three field stations showed that there was a peak of activity in the afternoon and a smaller one in the early morning. Slight activity observed at night was attributed to disturbance by the flashlights used. The collecting stations [*cf.* **42** 91] were on a bush trail 50 yards behind a village, in the central village clearing 25 yards from the nearest house and in a house partly surrounded by rank vegetation. The mosquitos were much more abundant in the bush than elsewhere and least abundant in the clearing. They were taken in moderate numbers in the house, but were found to be much less numerous in it some months later when the vegetation round it had been cleared. The range of dispersal, even in the bush, was only about 100 yards. Of 49 mosquitos recaptured out of over 800 marked and released, 37 were taken within five days at the points of release, seven at a distance of 50 yards after 3–23 days and five at a distance of 100 yards after 7 and 14 days. A clearing acted as a barrier to dispersal. Some 20 surveys between October 1948 and April 1951 showed that the activity of the females is reduced by strong sunlight, wind and rain where these can affect them directly, but weather does not seem to affect abundance in sheltered areas. No evidence of seasonal variation in population was observed in Samoa, where the seasons are not well marked. Resting mosquitos were not found in houses or other man-made shelters, but were seen in low vegetation, principally on the undersides of leaves of bushes sheltering breeding containers and in crannies in stone walls. Usual sites for oviposition were small natural or artificial water containers in well shaded areas. Coconut shells were preferred.

There is no evidence of autogenous reproduction. Man is the preferred host, but the females would feed on dogs, horses or pigs in nature and on a variety of animals in captivity. The mean period between emergence and first blood-meal in the laboratory was 3·3 days and successive meals were taken at intervals of about a week thereafter. The biting mosquito was quiet and persistent, and the bite relatively painless. A blood-meal weighed about 1·8 mg. and averaged 1·3 times the weight of the mosquito. Eggs were laid in cracks and niches of containers, just above the water line. The mean number per female per blood-meal was about 55. At 80°F., larval development took 6·9 days, and the mean period from hatching to adult emergence was 9 days for males and 9·4 days for females. The mean duration of life of adult females was 21·2 days at 80°F. and high relative humidity.

Macdonald (G.). **Medical Implications of the Volta River Project.**—*Trans. R. Soc. trop. Med. Hyg.* **49** no. 1 pp. 13–24, 9 refs. London, 1955.

The Volta River Project involves the damming of the river at Adjena in the Gold Coast to form an artificial lake some 2,300 square miles in extent and the establishment of a large industrial plant using the hydro-electric power so provided. The medical problems involved in the flooding of such

an area, the aggregation of great labour forces and their employment in a large industrial plant that has no analogy in tropical Africa are discussed. The arthropod-borne diseases considered are onchocercosis [caused by *Onchocerca volvulus*], which is endemic in the Gold Coast and transmitted there by *Simulium damnosum* Theo. [*cf. R.A.E.*, B **41** 147; **42** 145], malaria, mainly transmitted by *Anopheles gambiae* Giles and *A. funestus* Giles, and sleeping sickness [caused by *Trypanosoma gambiense*], which is transmitted by *Glossina palpalis* (R.-D.).

Onchocercosis is much the most important, because of the blindness it causes and its high incidence in the local population, and the consequent danger to the labour force that would build the dam. However, full control of *S. damnosum* has been obtained in two somewhat similar areas. These are on the Nile at Jinja, where DDT was used as a larvicide in the water, and on the Congo at Leopoldville, where it was applied from aircraft to the vegetation along the river banks for the control of the adults [**41** 202]. The former method would be satisfactory on the Volta only if control work carried out when the river was at low level prevented a flush of breeding during flooding, as it would probably be impossible to approach except by air at that time. If this breeding was not prevented, combined applications against adults and larvae from aircraft during the flood season would be necessary. This would be costly, but might be practicable if called for.

It is thought that the making of the lake must increase the breeding of both the important Anophelines and consequently the incidence of malaria, that it is not likely to produce grave epidemics owing to the pre-existing prevalence of the disease and immunity of the people, and that its incidence could be reduced by the use of insecticides against the adult mosquitos. Two of the measures employed for Anopheline control in the impounded waters of the Tennessee Valley would not be applicable; fluctuation of water level would not be compatible with the object of the Volta Project, and clearing of vegetation might increase the breeding of *A. gambiae* by creating sunlit pools in the area liable to periodic flooding.

Sleeping sickness has spread southwards into the Gold Coast following travel routes [**40** 5–6, etc.], and the danger with regard to it lies in increasing the contact between man and vector by promoting the breeding of *G. palpalis* in the littoral vegetation of the new lake, with transmission of the disease along its banks. *G. palpalis* is common in the forest zone, and increased transmission there is not necessarily to be expected as a result of breeding on the lake shore. The increased movement of people that might occur is of greater importance. The lake might become much used as a travel route. A valuable preventive measure would seem to be aggressive clearance of bush round the northern part of the lake and along approach routes to it, supplemented by clearing at the main points of disembarkation.

Robinson (M. C.). **An Epidemic of Virus Disease in Southern Province, Tanganyika Territory, in 1952–53. I. Clinical Features.**—*Trans. R. Soc. trop. Med. Hyg.* **49** no. 1 pp. 28–32, 1 fig., 12 refs. London, 1955.

Lumsden (W. H. R.). **II. General Description and Epidemiology.**—*T. c.* pp. 33–57, 5 figs., 8 refs.

In the first part of this paper, an account is given of the clinical features of a virus disease that occurred in epidemic form in the Southern Province of Tanganyika in 1952–53, and which appeared from these features to be dengue. This disease had not previously been recorded from the area.

The following is based on the author's summary of the second part. An

epidemic of a dengue-like fever affected the Newala and Masasi Districts of Southern Province, Tanganyika, during 1952 and 1953. The topography, climate, water supply, vegetation and population of the area affected are described. The disease was most active on the Makonde Plateau in Newala District, but the surrounding lowlands were also affected. The plateau, lying at about 2,000 ft. above sea level, is of sandstone, highly porous and practically devoid of surface water. The population, nevertheless, is dense and the people habitually store water in their houses, which are consequently infested with *Aëdes aegypti* (L.) and *Culex pipiens fatigans* Wied.

The first cases in the epidemic occurred on the south-eastern fringe of the plateau in July 1952. The densely populated south-western part became involved in September and thereafter spread was rapid. In January 1953, 49 of 62 localities were involved simultaneously. A rapid decline then set in. Incidence varied between 13 and 95 per cent. among 13 plateau localities and between 0 and 37 per cent. among eight lowland localities. In plateau localities in contact with woodland, the incidence in adults or adult males was significantly lower than in children. Escape from attack was most common among males over 45 years of age and was not associated with travel to coastal localities. It is assumed that these men were protected by some previous local experience not shared by the women and children. Once infection had been introduced into a house, all the inmates tended to be attacked.

The results of catches of insects in houses are reported, and the methods by which laboratory animals were inoculated in attempts to isolate virus are described. Virus was isolated from all the mosquito groupings used (*Anopheles* spp., *Aëdes aegypti* and *C. p. fatigans*) and possibly also from *Cimex hemipterus* (F.). The occurrence of the various arthropods in the houses and their habits are discussed in relation to the disease incidence. The evidence points to *A. aegypti* as the vector. Other related entomological work is reported, and a complete list of the biting arthropods seen is given. The rise and spread of the epidemic is discussed. It is considered likely that the disease originated in the Rovuma Valley and was spread about the plateau by natives visiting between hut groups. The behaviour of *A. aegypti* is discussed in relation to the spread of the virus. Its habit of biting on the verandah of huts by day is considered important.

Clyde (D. F.) & Shute (G. T.). **A Technique for the Investigation of Mosquito Feeding Preferences on Man.**—*Trans. R. Soc. trop. Med. Hyg.* **49** no. 1 pp. 64–67, 5 refs. London, 1955.

In view of the possible importance in the epidemiology of mosquito-borne disease of differential feeding by mosquitos on people of various age groups [*cf. R.A.E.*, B **43** 48], and of differences in individual attractiveness to mosquitos, a technique is described that enables the choice exercised by feeding mosquitos among different individuals asleep in a hut to be studied without the interference due to the presence of an observer. It is based on correlation of the leucocyte counts of human finger blood taken just before nightfall with those of the blood-meal of the mosquito. The blood-meals had to be examined within 1½–2½ hours of ingestion, and thick films were used mixed with saline, as the blood forms a soft gel when ingested, thus preventing the formation of thin films. Under tropical conditions it is uncommon to find two persons with similar leucocyte counts in a small family or group. However, factors are described that usually suffice to distinguish the films should this occur.

McCarthy (D. D.) & Fitzgerald (N.). **Researches in Western Samoa. III. Observations on Filariasis.**—*Trans. R. Soc. trop. Med. Hyg.* **49** no. 1 pp. 82–89, 7 refs. London, 1955.

An account is given of a filaria survey made in the village of Laulii on Upolu, Western Samoa, where filariasis is of the non-periodic type [caused by *Wuchereria bancrofti*]. The results, together with those of additional blood examinations made in the neighbourhood and on Savaii, are shown in tables. In Laulii, a filaria incidence of 47·7 per cent. was found in males of all ages and 26·5 per cent. in females. The incidence was much lower and the sex difference was greater than they were in surveys made about 30 years ago, and the grosser signs of infection were appearing ten years later in the age scale. It is suggested that this is at least partly attributable to clearing of village areas, which has made them less attractive to the vector, *Aëdes polynesiensis* Marks. This clearing would also partly account for the lower incidence of the disease in women and children, as they probably spend more of their time in the villages than do the men. An additional factor is probably clothing, as the women cover more of their bodies and limbs than do the men and more than women did 30 years ago. They are thus less readily accessible to mosquitos.

Papers noticed by Title only.

Gay (F. J.). **Common Names of Insects and allied Forms occurring in Australia.**—*Bull. Commonw. sci. industr. Res. Org. Aust.* no. 275, 32 pp. Melbourne, 1955.

Doss (M. A.) & Humphrey (J. M.). **Index-catalogue of Medical and Veterinary Zoology. Supplement 3. Authors: A to I.**—pp. [1+] 459–844. Washington, D. C., U.S. Dep. Agric., 1955. Price $1.25 (from Supt. Documents). [*Cf. R.A.E.*, B **43** 64.]

Sherman (M.) & Rosenberg (M. M.). **Subchronic Toxicity of four Chlorinated Dimethanonaphthalene Insecticides** [aldrin, dieldrin, isodrin and endrin] **to Chicks.**—*J. econ. Ent.* **47** no. 6 pp. 1082–1083, 3 refs. Menasha, Wis., 1954. [See *R.A.E.*, A **43** 422.]

Pengelly (R.). **Pesticides Quarterly Supplement no. 10, September 1955.**—pp. 455–486, 71 refs., multigraph. [Canberra] Dep. Hlth. Aust., 1955. [*Cf. R.A.E.*, B **41** 77; **43** 184.]

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